The Year Ahead: Interviews With Industry Experts

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Summer Consumer Electronics Show
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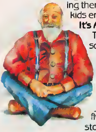

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FEATURES

EDUCATION AND RECREATION

REVIEWS

COLUMNS AND DEPARTMENTS

THE JOURNAL

NOTE: See page 265 before typing in programs.

GUIDE TO ARTICLES AND PROGRAMS

AP Apple **AT** Atari, **P** PET/CBM, **V** VIC-20, **C** Radio Shack Color Computer, **64** Commodore 64, **T/S** Timex/Sinclair, **TI** Texas Instruments, *All or several of the above.

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EDITOR'S NOTES

The recent TI announcement of a pending second quarter loss in the $100 million range sent shock waves through the consumer computer end of the stock market. In two days, TI stock dropped almost 50 points before beginning a gradual upturn. What's happening out there in the trenches of this economic warfare?

It would seem that Commodore is remaining profitable by constantly refining, redesigning, and maintaining rigorous internal cost controls. Various manufacturers, including TI, have been pulled into the trap of selling computers at loss leader prices. The expectation (perhaps more accurately the fervent hope) then becomes that money will be made on the software. With so much competition for software dollars only time will tell, but Commodore's recent and aggressive software price cuts don't bode well for the loss leader philosophy.

In Tom Halfhill's noteworthy article in this issue you'll discover an incredible array of information on the Consumer Electronics Show. Items of particular note: Atari has completely revamped their computer line, and Coleco introduces "Adam," a computer package of tremendous significance.

Random Bits and Rumors: With the advent of "Adam," we can expect to see new packaged systems to appear, most notably in the $500-$700 range. One recent concern we heard voiced regarding price cutting for computers: do people treat them less seriously as prices drop (e.g., is a $299 VIC-20 "more" of a computer than an $85 VIC-20)? It would seem that the manufacturers will have to convey the message that these are powerful, capable computers, and back that up with useful software. Commodore's *Magic Desk* (see Tom's article) is a good case in point.

IBM's new home computer is still under the tightest wraps. We still expect it by September or October and still expect a price in the $700 ball park. There's always the chance that IBM will sit back and watch the battle for a while to let things shake out a bit, but we think not. The IBM home computer would appeal to many on name alone, and IBM's well aware of that.

Robert Lock

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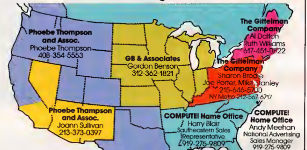

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READERS' FEEDBACK

The Editors and Readers of COMPUTE!

Commodore's Public Domain Software

Several readers have written asking about the public domain software released by Commodore. Earlier this year, Commodore announced that they were making 656 educational programs available to anyone, by placing them in the public domain.

Since that time, the software has been reorganized and has been distributed to Commodore dealers. All of the programs are educational (math, English, history, computer science, business, etc.) and are available through Commodore dealers. All programs are for the PET or the 64.

There are 27 diskettes available, each holding up to 20 programs, which are individually packaged and sell for $6.95. Also, copies can be made at Commodore dealerships for a nominal cost.

Since the programs have been placed in the public domain, all prices are, according to Commodore, charged only to offset actual disk costs or the time for dealer copying. None of the programs is available on tape.

What's RS-232?

I am confused with all this RS-232 jargon. I have read the section in the *VIC-20 Programmer's Reference Guide*, but it seems to be written for someone who is already familiar with RS-232. I'd like to interface a serial printer, and also a bar code concentrator – that's a buffer memory which stores ASCII received from several bar code scanning stations.

First, check **COMPUTE!** *(August 1982). "VIC-20 Communications/The RS-232 Interface" applies to both the VIC and the 64. In October, "Ask the Readers" gives more information on interfacing printer devices.*

However, neither of these references gives all the answers. Right now, there are users working on problems associated with the "full handshake" option, which doesn't work at all on the VIC and which has problems on the 64. Until Commodore releases a new ROM to fix the problem on either or both machines, users must go after the problem themselves by using machine language programming on an interrupt level – and that's a complex job. **COMPUTE!** *should soon be able to publish a success story on how it's done.*

VIC Disk Details

After reading through the VIC-1541 Disk Drive manual some questions arise:

1. How can the 1541 be speed-changed for the VIC-20 through software if the 1541 is in the 64 mode to start with? Will it recognize such a software command if in the wrong speed mode?

2. What are the considerations in using a second disk drive? The manual discusses changing the "8" drive number to another via software or hardware, but which is preferable? And would most programs one buys have to be modified if the drive address is changed? And when would one profitably use a second drive – main program of first drive and data files on another, or what?

3. The manual briefly alludes to drive numbers but does not explain the connection between drive numbers and device numbers. Is there a connection, and how would a drive know its drive number (as opposed to its device number)?

4. The 1541 manual says that you can't copy whole disks from one 1541 to another 1541. Is this really true? Is it immutable, or is there a way around this glitch?

Karl Thurber

The difference in data transfer speed between the VIC and 64 is not so great that the drive in its 64 mode is unable to understand commands sent to it by the VIC. In fact, the VIC can usually read programs from the disk without giving the "slow down" command. To write data reliably, however, you should always set the drive for the proper speed by typing:

```
OPEN 15,8,15,"UI-":CLOSE 15
```

When peripherals are connected to the serial bus, the computer must know what to call them before it can talk to them. If you attach two disk drives without changing the device number of one of them, they will lock up the bus in an electronic argument over which one has the right to call itself device 8. The simplest solution is to perform the hardware modification described in the manual, which changes the device number once and for all. The problem with this is that it's a little drastic for most people. The procedure for changing

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Hardware requirements: Apple version requires Apple II or Apple II + with 48K and Applesoft in ROM or language card, DOS 3.3. Atari 400/800 version requires 48K and BASIC cartridge. Both versions require only one disk drive.

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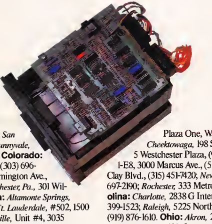

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the device number via software is to turn on one of the drives and the computer, load and run the "DISK ADDR CHANGE" program on the demonstration diskette supplied with the drive, then turn on the other drive (which will then be device 8).

Since Commodore's standard device number for disk drives is 8, software that reads or writes to disk will probably make this assumption, which means that to use those programs without modification you'll have to use only the first drive. Having multiple drives becomes profitable at the point where the convenience of not having to constantly switch disks becomes worth the cost of a second drive. The example you cited, using one drive for programs and the second for data files, is a very common one. Also, some tasks, such as duplicating disks, are inherently less complicated when you have more than one drive.

For dual drive units such as Commodore's 4040 and 8050, both drives have the device number 8. To distinguish between them, one is designated as drive 0 and the other as drive 1. Drive numbers are not truly relevant to single drives (where the unit is always drive 0); however, this feature was retained in the DOS (disk operating system) for the 1541 to maintain compatibility with the Commodore dual drives, and to leave open the possibility of dual drive units for the VIC and 64.

It is possible to copy whole disks from one 1541 to another as long as the device number of one of them has been changed. A program called "COPY/ALL" by **COMPUTE!** *Associate Editor Jim Butterfield, which copies the contents of a disk in device 8 to a disk in device 9, is provided on the demonstration disk which comes with the 1541 drive.*

More On TI Memory

Many owners of the TI-99/4A would be interested in determining the exact amount of available memory (in bytes). This two-line program is very simple and can save a lot of hair pulling when you write programs which fill the memory. Here is the program:

STEP 1

Enter the following:

```
1 A=A+8
2 GOSUB 1
```

Do not use a variable that has already appeared in the program. For example, if you have used the variable "A" within the program, choose another. Second, the program must work correctly before using this mini-program.

STEP 2

Once this is entered into the memory, enter the RUN command. The process will take between 15 and 30 seconds to execute, depending upon the length of your program. After execution, MEMORY FULL IN 1 will appear. Now enter PRINT A (no line number) and a value will appear on the screen. This value is the number of bytes remaining in the computer's memory.

To determine the total amount of free memory available, clear the memory (store your program first) and repeat Steps 1 and 2. The value displayed will be 14536. There are 14536 free bytes available (the mini-program itself uses 40 bytes, so add 40 to the 14536). The computer is advertised as having 16K bytes. 1424 are used for screen display, etc. So, when a program is stored in the memory and you want to determine how many bytes the program used, enter the following:

```
PRINT 14576-A
```

Howard Patlik

80 Columns For The Commodore 64

The February "Readers' Feedback" discussion of Commodore 64 add-ons stated 80-column format could be achieved by use of other manufacturers' products, but would "require a separate video monitor" instead of a TV set.

I am considering a color monitor to use with my Commodore 64 and will eventually want to use it as a word processor with 80 columns. The Commodore 64 will only work with a composite input color monitor. I am confused as to the capabilities of that type of monitor. Will it handle the 80-column format, or will I have to get an RGB type color monitor along with some type of interface converter?

R. C. Freytag

The good news is that composite input color monitors give a reasonably good display for 80-column format. The bad news is that, at present, the 80-column boards all have black and white output, so the color monitor is no particular advantage. Also some word processing programs are not designed to work with the 80-column add-ons, so make sure before you buy that the items you are purchasing will work together.

Flashing Atari Prompt

I was intrigued by Glenn Murray's "Flashing Prompt For VIC and PET" (**COMPUTE!**, December 1982). It was just the thing for a number of my programs. It was easily adjusted for my Atari. I offer the re-worked program for your readers:

```
10 POKE 752,1
20 DIM A$(30), B$(30), X$(30)
30 A$="PRESS ANY KEY TO CONTINUE"
40 B$="{CLEAR}"
50 X$=A$
60 FOR R=1 TO 100
70 POKE 656,2: PR. X$ : REM ***PRINTS MESSAGE
   IN WINDOW***
80 FOR W=1 TO 333:NEXT W
90 IF PEEK(764)=255 THEN 110
```

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```
100 IF PEEK(764)<>255 THEN RETURN :REM
    ***THIS GOS. RETURNS**
110 IF X$=A$ THEN X$=B$:NEXT R
120 IF X$=B$ THEN X$=A$:NEXT R
```

Note: Line 100 returns this GOS. routine to the main program. When you return the first entry should be, POKE 764,255:PR. B$.

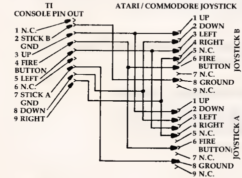
Barry E. Krischer

How To Build Your Own TI-99/4A Joystick Adapter

As an owner of a TI-99/4A, I decided I wanted a joystick to go with it. To save time and money, I got the Atari pin configuration from a friend and TI's configuration from the TI toll-free information line. After that it was a simple matter of buying three nine-pin "D" connectors (two male and one female), a small box, and some wire. Following this wiring diagram, you can make this adapter in about an hour and be able to select any joystick from the wide variety of Atari-compatible joysticks sold.

Gary Cook

Thanks for the suggestion. We built it here and it works perfectly.



Extended BASIC For The 64?

Is there an extended BASIC available for the Commodore 64? If so, does the extended version include commands for the superb graphics capabilities of the 64?

David J. McKeehan

The 64 comes with a version of Commodore BASIC called "Upgrade" or 2.0 BASIC. This version does not contain disk commands like the newer PETs, nor does it contain special commands for graphics as on the Atari or the TI with extended BASIC.

Fortunately, there are several ways that BASIC on the 64 can be improved. By plugging in cartridges, you can effectively increase your amount of ROM memory. Commodore has plans to release a VSP (Video Support Package) cartridge that will add the graphics commands BASIC presently lacks. There are also cartridges available commercially that add disk commands of BASIC 4.0.

Another way to extend BASIC is with programs that "patch" into it through a machine language program like BASIC AID 64 *that will appear in an upcoming issue of* **COMPUTE!**.

The last and most ambitious method is to make the ROM "invisible" and replace BASIC with another program running in the RAM underneath. This should make it possible to run languages such as Pascal or the new BASIC in the Commodore P128 series computers, without much sacrifice of RAM memory.

Atari Assembler Graphics

I have an Atari 800 and I'm currently using the Assembler Editor cartridge. I can't seem to instruct the computer to switch graphics modes. I've fiddled and faddled here and there with addresses, but it doesn't display a mode that doesn't have garbage all over it. When I read the "Boing" game in **COMPUTE!** ("Insight: Atari," August 1982) I typed in the subroutine and it didn't work. Using the BASIC cartridge and calling up the program after a graphics call seems like a cop out. Help!

Mark Macuirles

*For information on calling graphics modes from machine language, refer to "Insight: Atari" (***COMPUTE!***, February 1982). Bill Wilkinson presents a modular set of routines for GRAPHICS, PLOT, DRAWTO, etc. It is not a program, but rather a series of routines that you can include in your programs.*

COMPUTE! *welcomes questions, comments, or solutions to issues raised in this column. Write to: Readers' Feedback,* **COMPUTE!** *Magazine, P.O. Box 5406, Greensboro, NC 27403.* **COMPUTE!** *reserves the right to edit or abridge published letters.*

David D Thornburg, Associate Editor

The Continuing Evolution Of Languages

Last month we discussed the ongoing Japanese development of a new generation of computer as described in *The Fifth Generation*, a book by Edward Feigenbaum and Pamela McCorduck. This ten-year development project promises to have a lasting impact on our concept of computers. While I didn't elaborate on the topic, I think that the choice of computer language to be used with these machines will be as important as the details of the machine architecture itself. It was thus interesting to find that the language chosen for the fifth generation machines is Prolog.

I had not heard of this language before, and I decided that I should check with some of my Stanford friends to see if they knew about it. With their help I was directed to an excellent guide to this language: *Programming in Prolog*, by W. F. Clocksin and C. S. Melish (Springer-Verlag, $16).

There are two things that surprise me about this language. The first is its tremendous power, and the second is that it has been around since the early 1970s. Interestingly, *Programming in Prolog* (published in 1981) is the first book to appear on this language. The authors wrote the book while they were at the Department of Artificial Intelligence at the University of Edinburgh, a school that has long been a center for Prolog research.

Prolog is used primarily for symbolic computation. Many of its applications are the standard fare of artificial intelligence research – abstract problem solving, mathematical logic, understanding natural language, and the creation and exploration of relational data bases. In other words, Prolog is being used in many applications for which LISP or Logo otherwise might be considered the language of choice.

Creating Facts

To get some picture of Prolog's power, let's examine some program statements. One of the basic structures in Prolog is the "fact." A fact is created in the following way. Suppose we wanted to express the idea that David is a friend of Pam. To express this in Prolog, we would write:

```
friend(david,pam).
```

We could create some more facts by entering:

```
female(pam).
male(david).
```

and so on.

A fact in Prolog consists of a relationship followed by the objects of the relationship, separated by commas and placed inside parentheses. The names chosen for objects and relationships are totally up to the programmer, as long as the names of constants start with lowercase letters. Each complete Prolog statement must end with a period.

Once a collection of facts has been entered into the computer, the data base can be asked to examine the validity of an assertion. Suppose, for instance, that the following facts were present in the system:

```
likes(joe,fish).
likes(mary,book).
likes(joe,mary).
likes(john,book).
```

We can ask a question in Prolog by typing ?- followed by the assertion we want to test. If we typed:

```
?- likes(joe,money).
```

the system would type:

```
no
```

because there is no fact present in the system to confirm the validity of this assertion. If, on the other hand, we typed:

```
?- likes(joe,mary).
```

Prolog would search its data base until it found the desired fact, at which point it would type:

```
yes
```

on the display screen.

Variables

While this application may not appear very powerful, consider the way that Prolog uses variables. Suppose we wanted to know something that Joe likes. To find something we would type:

```
?- likes(joe,What).
```

The word "What" is a variable. Variables can have any name the programmer desires, as long as they start with an uppercase letter. On receiving this question, Prolog searches its data base to find the relationship "likes" and the object "joe." Once it has found these, it then sets the value of "What" to the remaining object. The screen would then show:

```
What = fish
```

since this is the first thing that was shown for the desired relationship. When Prolog finds a match, it places a marker at the relevant fact in case you want to search for other matches. To find other things that Joe likes, one just presses the semicolon (;) key and RETURN. Prolog continues its search and prints:

```
What = mary
```

This process can be continued until the search fails. This aspect of Prolog is very similar to the use of "property lists" in Logo.

Factual Relationships

Questions can be asked about conjunctions of facts also. For example, if one were to ask if there is something that Mary and John both like, one would write:

```
?- likes(john,X), likes(mary,X).
```

The comma is used in Prolog to represent the logical AND operation. At this point you should be able to convince yourself that the computer will print

```
X = book
```

as a response.

In addition to facts, Prolog programs are constructed from rules. An example of a rule is "X is a sister of Y if X is a female and X and Y have the same parents." In Prolog, this rule could be written as:

```
sisterof(X,Y) :-
        female(X),
        parents(X,M,F),
        parents(Y,M,F).
```

The Prolog primitive :- stands for "if."

Suppose we now had the following entries in the data base:

```
female(kathy).
female(pam).
female(pat).
male(greg).
male(david).
parents(kathy,cleo,bob).
parents(pam,virginia,ernie).
parents(david,cleo,bob).
parents(greg,virginia,ernie).
```

With the "sisterof" procedure in place, we can ask questions like:

```
?- sisterof(kathy,david).
```

to which the computer would respond with a "yes" answer. Alternatively, we could find out if Greg has a sister by entering:

```
?- sisterof(X,greg).
```

to which the computer would reply:

```
X = pam
```

It doesn't take much imagination to see that Prolog programs can be written to solve many types of logic problems.

In addition to manipulating objects and variables, Prolog also works with lists. The Prolog data base (consisting of both facts and rules) is searched by a technique called "backtracking" which insures that matches will be found if they occur anywhere in the data base. By moving back and forth in the program, Prolog differs from languages like BASIC in which commands are followed in strict order. If Prolog is unable to answer a query with one set of objects, it will backtrack and start over with a new set until it has found a solution or has exhausted the data base. This feature of the language is one reason that Prolog has thus far appeared primarily on large computers such as the DEC PDP-10. Unless Prolog programs are compiled, they would run quite slowly on personal computers.

And yet this powerful language will probably appear on small computers for many of the same reasons Logo did. When people get sufficiently interested in a language, some enterprising programmer will implement it. There is already a CP/M-based version of the language available from England. I haven't seen it yet, so I can't comment on it. As the impact of the "fifth generation" starts to be felt, Prolog will become more generally available on personal computers.

While the description of Prolog given above is necessarily quite incomplete, it does give some of the flavor of the language. Next month we will explore other powerful languages that are hiding right under our noses. You may be surprised to see what they are! ©

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EXPANDABLE TO	144K**	64K	48K	N/A	32K	16K
KEYBOARD FEATURES						
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USER DEFINE FUNCTIONS	10	N/A	4	8	10	NONE
SPECIAL WORD PROCESSING	YES	NO	NO	NO	NO	NO
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BUILT IN JOYSTICK	YES	NO	NO	NO	NO	NO
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RESOLUTION (PIXELS)	256 x 192	280 x 160	320 x 192	320 x 200	256 x 192	128 x 64
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OCTAVES PER CHANNEL	8	4	4	9	8	10
A D S R ENVELOPE	YES	NO	NO	YES	YES	NO
PERIPHERAL SPECIFICATIONS						
CASSETTE	2 CHANNEL	1 CHANNEL	2 CHANNEL	1 CHANNEL	1 CHANNEL	1 CHANNEL
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The Fall Computer Collection At The Summer Consumer Electronics Show

Tom R Halfhill, Features Editor

The flood continues: at least 17 new personal computers were introduced at the Summer Consumer Electronics Show in Chicago, and the end is not in sight. Among industry leaders, Atari made the biggest showing with a completely revised line, plus a radical new approach to software merchandising; among the newcomers, the strongest challenge came from Coleco.

It's been only recently – maybe a year or two – since home computer shoppers have had more than a handful of machines to choose from. Apple, Atari, Commodore, Radio Shack, Texas Instruments. Still, people agonize over the decision.

By this Christmas – destined to be called the Christmas of the Computers – there should be 30 to 40 under-$1000 personal computers for shoppers to sort out. Computers of almost every conceivable variation, from about $40 for a minimal 2K memory machine to upwards of $1000 for a full-blown 64K personal computer with built-in modem, speech synthesizer, and double-sided/double-density disk drive.

How will people choose from this bewildering array of equipment? According to industry analysts, the majority will stick with the established leaders – Commodore, Texas Instruments, and Atari. "The window is closing," says one consultant, "for new entrants in the low-end home market." They expect many, if not most, of the new arrivals to be forced out within the next year. In other words, the rich will get richer as the poor get poorer (perhaps a misleading expression, given the aggressive price wars which are driving even the Big Three toward the corporate poorhouse).

Yet, a few of the newcomers are making strong challenges, as evidenced by the hardware they displayed at the recent Summer Consumer Electronics Show in Chicago. In particular, the talk of the show was Coleco's entry into the field with an integrated system that includes an 80K computer with detachable keyboard, high-speed tape drive, letter-quality printer, and software, complete for under $600 – only $450 if you already own a Colecovision game machine. But no one was ignoring Atari, either. Atari scrapped its entire home computer line – including the brand-new but much-maligned 1200XL – in favor of a completely new line of four computers and numerous accessories. Considering the financial problems dogging Atari and TI, plus the approaching entry of IBM into the home market, it appears that the next 12 months will be a make-it-or-break-it year even for the "established leaders." In short, no one can afford to sit back and rest easy. And no one is.

Here's a rundown of the most significant developments at the Summer CES:

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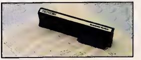
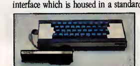
If you own a TS-1000 or ZX-81 computer and want to bring out the power within it, you'll want Memotech. From easier input to high quality output and greater memory, Memotech makes the add-ons you demand. Every Memotech peripheral comes in a black anodized aluminum case and is designed to fit together in "piggy back" fashion enabling you to continue to add on and still keep an integrated system look.

MEMOPAK RAM All Memopak RAMs are directly addressable, user transparent, are neither switched nor paged and no additional power supply is required. You can also choose the Memopak RAM which is just right for your needs. From economy to power. **16K RAM** The Memopak 16K RAM is the most economical way to add memory to your TS-1000. It is fully compatible with the Timex or Memotech 16K RAMs to provide you with up to 32K of RAM. The 16K RAM also offers additional add-on capabilities through its "piggy back" connection. **32K RAM** The 322K Memopak enables you to execute sophisticated programs and store large data bases and like the 16K RAM is fully compatible with Timex's or Memotech's 16K RAMs to give you a full 48K of RAM. **64K RAM** The 64K Memopak is powerful enough to turn your TS-1000 into a computer with capabilities suitable for business and educational use. It accepts such BASIC commands as 10 DIM A (9000). **MEMOCALC** Memocalc, our spreadsheet analysis software, enables TS-1000 users to perform complex number crunching routines with ease. With the 64K RAM a table of up to 7000 numbers with up to 250 rows or 99 columns can be specified. Quick revisions can be achieved by entering new data to your formula.

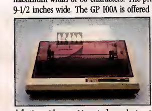


MEMOTECH KEYBOARD For ease of operation, the Memotech keyboard is a high quality standard typewriter keyboard, with TS-1000 legends. The keyboard is cable connected to a buffered interface which is housed in a standard Memopak case and plugs directly into the back of the TS-1000 or other Memopaks. **MEMOPAK HRG** The Memopak High Resolution Graphics, with up to 192 by 248 pixel resolution, enables display of high resolution "arcade game" style graphics through its resident 2K EPROM, programmed with a full range of graphics subroutines.



CENTRONICS PARALLEL AND RS232 INTERFACES Memotech's Interfaces enable your TS-1000 to use a wide range of compatible printers. The resident software in the units gives the complete ASCII set of characters. Both Memopak Interfaces provide lower case character capabilities and up to 80 column printing. The RS232 Interface is also compatible with modems and terminals.

SEIKOSHA GP 100A PRINTER The Seikosha GP 100A uses a 5x7 dot matrix printing format with ASCII standard upper and lower case character set. Printing speed is 30 characters/second with a maximum width of 80 characters. The printer uses standard fanfold paper up to 9-1/2 inches wide. The GP 100A is offered as a package including cable and interface. Other printer packages are also available through Memotech.



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Printer Cable	19 95		
GP 100A Printer Package**	399 00		
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TOTAL			$

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Coleco's Adam

By the first day of the show it became apparent that Coleco's new "Adam" home computer was the system to beat. After Coleco shattered price barriers by introducing an impressive grouping of hardware and software for under $600, Commodore announced a similar package deal for under $1000, built around its newly discounted Commodore 64. And Atari told *The Wall Street Journal* it could offer a comparable system with the new 600XL and a letter-quality printer, also for under $600. Another competitor, newcomer Unisonic, even went so far as to redesign its prototype computer *at the show* – and then they stationed a pretty woman next to the Coleco display to pass out photocopied announcements.

Coleco's "Adam" system – the talk of the show.

Just what set everybody scrambling? Adam definitely *is* a price breakthrough, even if (at this writing) all the design specifications are not finalized. Adam has 80K of Random Access Memory (RAM), expandable to 144K (although it's not yet clear how much of this RAM is actually available to the user); a Z80A chip for its Central Processing Unit (CPU), allowing CP/M compatibility; a 75-key, full-stroke, typewriter-style keyboard that detaches from the main box on a coiled cord, much like the IBM PC (in fact, the keyboard strongly resembles the IBM PC's); a very high-speed cassette tape drive which Coleco claims is "comparable to a disk drive," and which stores 500K per cassette; a letter-quality daisy wheel printer; Applesoft-compatible Microsoft BASIC; a TI sound chip with three sound channels; 32 sprites (programmable shapes for animation); four expansion slots; a slot for ROM cartridges and Colecovision games; built-in word processing software; two joystick controllers with keypads, which also can control the cursor; and even an arcade-style game to get you started, *Buck Rogers Planet of Zoom*.

And yes, Coleco promises to sell the whole package for under $600. If you already own a Colecovision game machine, you can buy a functionally identical version of Adam that plugs into your unit and costs only $450. Coleco says Adam will be available this fall.

Options will include an adapter for playing Atari VCS 2600 video game cartridges, a second tape drive (built into the main box with the first drive), an 80-column screen adapter, and accessories to allow running CP/M (Control Program for Microcomputers), an industry-standard operating system that allows access to thousands of programs, mostly business-oriented.

Interestingly, Adam was one of three new computers at CES with Applesoft-compatible BASIC. However, Adam's internal memory arrangement is different from the Apple's, which means the majority of Applesoft programs will not run until the PEEKs, POKEs, and CALLs are translated. Also, Coleco representatives said they didn't know if the BASIC includes new commands to support features which Adam has but the Apple does not, such as sophisticated sound and sprite graphics. Other graphics seem to be the same, with 16 colors and a high-resolution mode of 256 by 192 pixels (screen dots).

Will Coleco's Adam be a significant challenge to Commodore, TI, and Atari, which have tremendous head starts? Remember that Coleco proved in the past year it could crack open what some analysts thought was almost a closed market – the video game machines – and still make a strong showing despite a late entry. Expect a hard-charging advertising campaign to win similar success for Adam in the months ahead.

Atari's Clean Sweep

Even Atari acknowledges it has been undergoing some rough times lately. Its profits have been seriously eroded by increased competition and by one of the most dramatic price wars in consumer history. Its image suffered when mounting losses prompted the company to shift manufacturing overseas, eliminating more than a thousand American jobs. And its top-line home computer, the Atari 1200XL, was introduced only a few months ago to something less than critical acclaim.

It was immediately obvious at CES that Atari had decided it was time for drastic action.

First, Atari reorganized its corporate structure, consolidating the home video game and

home computer divisions. This is more than just a corporate shuffle. It should avoid future conflicts between the two entities, such as the present incompatibility between the home computer division's machines and the video game division's recently announced add-on keyboard for the Atari 2600 VCS.

Second, Atari made a move that some industry analysts are labeling the most significant development of the year – a new subsidiary, Atari Publishing, will begin producing hit software for competing computers, including arch rivals Commodore and TI.

Third, Atari has completely restructured its home computer line. Its entire current lineup — from the four-year-old 400 and 800 to the struggling 1200XL – has been discarded. Atari is betting everything on a new line of four redesigned computers and an array of impressive accessories and peripherals.

Fourth, Atari is acknowledging the importance of support from third-party manufacturers and the grassroots. The new computers are designed to be easily and almost infinitely expandable, and their architecture is "open" – freely available to independent companies that want to make accessories. What's more, to assure that the new machines are better received on the grassroots level than the ill-fated 1200XL, Atari flew 15 top user group officers from all over the country to CES, all expenses paid.

The problems of the past 12 months appear to have galvanized Atari, and the company is responding with an all-out effort to recover its position in the marketplace.

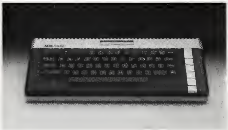
The XL Series

Atari's new XL computers range in list price from $199 to an unannounced top end that will be about $1000. Not only are they hardware- and software-compatible with each other, but best of all, they are fully compatible with the discontinued models. That includes almost all the new peripherals and accessories.

The computers are compact, attractive, incorporate the best features of the 1200XL plus some new ones, and together form a comprehensive product lineup:

• *Atari 600XL.* The low-end computer, with a suggested retail of $199 that most likely will be discounted, comes with 16K RAM expandable to 64K. Like all the XL computers, the 600XL has a rear slot with an edge connector that is a "full processor bus" – an extension of the main circuit board (motherboard). This slot is the key to the almost limitless expansion of the XL series. As detailed below, it allows almost anything to be added to the computers, even co-processors, as on the Apple. The 600XL's expansion slot accepts a 48K memory module that brings the computer up to a full 64K for about $100. This would make it identical in features and price to the next model, the 800XL, except for the lack of a monitor jack.

Also in common with the other XL computers, the 600XL has built-in Atari BASIC. It has a full-stroke, typewriter-style keyboard with non-glare keycaps, a topside slot for ROM cartridges, and 24K of Read Only Memory (ROM), which includes the BASIC language and operating system.



Atari 600XL, 16K RAM.

The operating system of all the XL series computers appears to be nearly identical to the 1200XL's. This means all four machines have most of the features introduced by the 1200XL, such as the HELP key, the international character set, self-testing, and the ability to disable ROM to access extra RAM underneath. For instance, disabling BASIC – formerly accomplished by unplugging the separate BASIC cartridge – now is done by holding down the OPTION key while switching on the computer, or via POKEs from within a program.

In addition, the XL series retains the traditional Atari features, such as 256 colors, four sound channels, five text modes, eleven graphics modes, hi-res graphics of 320 by 192 pixels, programmable character sets, up to five sprites, separate chips to handle the screen and graphics, a serial port for adding peripherals, and so on. However, there are only two joystick ports instead of the usual four.

• *Atari 800XL.* As described, basically this is a slightly larger, 64K version of the 600XL. At a suggested retail of $299, it costs the same as a 600XL expanded to 64K, although the built-in memory makes it less unwieldy. The only difference would be the monitor jack, absent on the 600. Even the keyboards are identical, but they do differ slightly from those on the upper-end models, the 1400XL and 1450XLD. The lower-end computers have non-glare keycaps and lack the four special function keys (F1 through F4) first seen on the 1200XL.

We just made owning an Atari computer a lot more logical.

Atari 800XL, 64K.

Atari says the 600XL and 800XL should be available by the time you're reading this.

• *Atari 1400XL.* This is the model that most closely resembles the discontinued 1200XL (in fact, one Atari spokesperson told us – in jest, perhaps? – that a warehouse-full of 1200XLs might be converted into 1400XLs). Its outward appearance is virtually identical to the 1200XL's in every detail except the one that triggered most of the criticism against its late brother – the 1400XL has a rear expansion slot. Inside, it also adds two impressive new features, both built-in: a direct-connect modem and a speech synthesizer.

Although the 1400XL's price was not announced, sources say it will be in the $500-$600 range. Atari says it will be available in the fall.

Atari 1400XL, with 64K, built-in modem and speech synthesizer.

• *Atari 1450XLD.* Topping off the new Atari line, the 1450XLD has all the features of the 1400XL – including the 64K RAM, built-in modem, and speech – and adds a built-in, double-sided/double-density disk drive. The drive stores up to 254K per 5¼-inch disk and is two and a half times faster than the current drives (which store only 92K). A magnetically isolated disk-storage compartment alongside the drive can be converted to a second drive later. Also, the new drive will recognize and read the current disks (details below).

The 1450XLD's price also was not announced, but should be around $1000. Atari says it will be available by Christmas.

Making The Atari Talk

The modem and voice synthesizer aboard the 1400XL and 1450XLD are well-integrated with the rest of the computer. The 300-baud modem is handled as the "T" device (for telecommunications or telecomputing); the voice, as the "V1" device. In other words, the modem and voice are addressed as easily as any other device supported by the operating system, such as the screen, keyboard, disk drive, cassette recorder, printer, etc. This simple BASIC program will make the 1400XL or 1450XLD greet you with a "hello":

```
10 DIM A$(10)
20 A$="HELLO"
30 OPEN #1,4,0,"V1:PF"
40 PRINT #1;A$
```

Atari 1450XLD, with 64K, built-in modem, speech synthesizer, and double side/double density disk drive.

As on all Ataris, the voice emanates from the TV speaker. The speech, created by a Votrax chip, is comparable to the Voicebox sold for Atari and Apple computers by the Alien Group. It's easily understood, but unmistakably a computer.

Addressing the modem and voice as standard Atari devices provides great flexibility. For instance, an Atari spokesperson told us the voice can just as easily be sent through the modem. And the computer includes built-in software to operate the modem.

Also, there are three speech modes. Notice line 30 above: OPEN #1,4,0,"V1:PF" opens a device channel to the voice in *phoneme* mode. Phonemes are the phonetic building blocks of a spoken language. For the best speech, words should be spelled phonetically. "ATARI" is spelled "UHTAHREE." In this mode, the computer ignores certain consonants which might confuse the synthesizer, such as C and X. For a "soft" C, you must use an S; for a "hard" C, a K. Similarly, an X is spelled EKS. The other two speech modes are *alpha* and *numeric*. Alpha is a

more direct text-to-speech mode. The numeric mode allows voice programming in machine language.

Interestingly, we found that hitting BREAK while the computer is talking does not shut up the voice. This has always been true of sounds created with the four sound channels. This may mean that synchronizing speech with screen graphics could be a relatively simple programming task.

Atari's New Peripherals

Atari engineers must have been awfully busy for the past year. Besides all the new computers, Atari introduced a slew of new peripherals and accessories. Most of them work with the discontinued models, too. A summary:

• *Atari 1050 Disk Drive*. This double-density drive replaces the old 810 unit. It stores 127K per disk. It is not double-sided, as is the 1450XLD's on-board disk drive, which may not be available separately. The 1050 is trimmer than the 810, designed to match the XL series computers, and it automatically recognizes and adjusts itself for the current single-density Atari disks. Thus, it is fully compatible with both old and new systems. It should be available immediately at a list price of $449. However, until the new double-density DOS III (Disk Operating System) becomes available this fall, it will be shipped with the single-density DOS II. We saw a preliminary version of DOS III with instruction screens that could be summoned at a touch of the HELP key, plus a new option on the DOS menu called "Convert DOS II." Old disks can be converted to double-density with this option.

• *Atari CP/M Module*. This small box adds CP/M capability to any Atari computer when plugged into the serial port – which means it also works on the older models. It contains a Z80 microprocessor, 64K RAM, CP/M 2.2 operating system, switchable 40/80 column screen adapter, a serial port, and a monitor jack. This last feature allows CP/M and 80-column video even on Atari's lowest-priced models, the 600XL and old 400, which do not come with monitor jacks. Compatible with the 1050 and old 810 disk drives, the module brings thousands of (mostly business-oriented) CP/M programs within reach of Atari users. It should be available by the end of this year. The price is unannounced, but sources peg it at under $400.

• *Atari Expansion System*. With this box, the XL series can be expanded almost without limit. It plugs into the rear expansion slot and thus is compatible only with the new computers. It adds two RS-232C serial ports, a Centronics-standard parallel port, and most importantly, eight card slots. The slots could accept 80-column cards, extra memory, RAM-based disk emulators, coprocessors for CP/M or IBM compatibility – almost anything. Atari, however, is expecting third-party companies to supply most of these add-ons. The architecture is open to everyone. (The box is the XL series' counterpart of the old 850 Interface Module, which Atari says it will continue manufacturing until demand dries up.)

• *Atari 1027 Printer*. This amazing letter-quality, 80-column printer retails for only $349. One-third the size of most printers, it uses standard typing paper, prints bidirectionally at 20 characters per second, and even underlines. It plugs into the serial port and works with the older models as well.

• *Atari 1030 Modem*. This is a 300-baud, direct-connect modem that permits phone numbers to be dialed from the computer keyboard. The price has not yet been announced.

• *Atari Touch Tablet*. With this pad and its stylus (or your fingers), you can draw pictures and diagrams, write script, or select menu options. There are two fire buttons on the tablet and another on the stylus. The tablet plugs into the joystick ports and has a drawing surface of 4½ inches by 6 inches.

• *Light Pen*. When the 400 and 800 were first introduced a few years ago, Atari announced – and even demonstrated – a light pen. Then problems cropped up and the light pen disappeared. Now it's back, and we saw it really work. You can draw and paint on the screen in different colors, choose from menus, and so on. No price yet, but Atari promises the pen will be in stores by the end of the year.

• *Trak-Ball, Remote-Control Joysticks*. The long-awaited Trak-Ball operates as either a true positional trackball or as a directional trackball, so it can substitute for an Atari joystick. The price is $59.95. The remote-control joysticks are jumbo versions of the standard Atari controllers with protruding antennas. A receiver plugs into the joystick ports. Range is about 20 feet. The price is $74.95 per joystick with receiver.

The computer keyboard for the VCS also was displayed at the show – in early prototype stage (see "Atari's New Add-On Computer For VCS 2600 Game Machine," **COMPUTE!**, May 1983). The keyboard has been slightly redesigned since it was first announced a few months back. Atari has renamed it "The Graduate" instead of "My First Computer." It is still planned to sell this fall for under $90, and some predict the VCS itself will drop to around $40 by then (at this writing, the going price is $79).

Atari also introduced more software than we have room to mention, including games, educational programs, graphics utilities, and the Logo programming language on a 16K cartridge.

Atari Publishing

Realizing that there can be a greater market for home computer software than hardware – especially with the price wars going on – Atari's biggest software news of the show was its decision to sell programs for competing computers. Although this will help alleviate one of the problems with the competition that Atari cites in its advertising, the profits will be welcome. The new Atari Publishing subsidiary will sell hit games for the TI-99/4A, the Commodore 64 and VIC-20, the Apple, and the IBM PC.

All these computers will get versions of *Pac-Man*, *Centipede*, *Defender*, *Dig Dug*, and *Donkey Kong*. In addition, there will be versions of *Stargate* for the VIC-20, Commodore 64, Apple, and IBM PC; *Robotron* for the VIC-20 and 64; and (licensed from Synapse) *Shamus*, *Protector*, *Picnic Paranoia*, and *Slime* for the TI.

The games will come on cartridges for the TI, VIC, and 64, and on disks for the Apple and IBM. Prices range from $34.95 for disks to $44.95 for cartridges.

Commodore Strengthens Software

On the hardware front, Commodore was relatively quiet at this CES, at least compared to the blockbusters they dropped at the last two shows. No new computers were announced. A few previously announced but still-to-be-introduced computers and peripherals were shown again, and one computer was dropped before reaching the market.

But even when Commodore is "quiet," it is far from silent. Fueling the price wars further, Commodore chopped the wholesale cost of the Commodore 64 from about $360 to $200, which means retail prices at some outlets should be $250 or less by mid- to late summer.

In addition, prices on printers and disk drives were cut up to $100, and software prices were cut up to 50 percent.

Commodore's biggest news was its efforts to strengthen software support for its computers. A beefed-up software division has been formed, and more than 70 new packages for the VIC-20 and 64 were announced at new low prices. Examples are *Easyscript 64*, a word processor for under $50, *Multiplan*, a spreadsheet for under $100, a small business accounting package of five programs for under $250, and *Magic Desk I – Type and File*, an under-$100 program that one spokesperson called "Commodore's answer to Apple's Lisa."

Magic Desk I, a cartridge for the 64, is the first of a series of programs aimed primarily at home users. The screen comes up with a picture of a room containing a desk, typewriter, index file, telephone, calculator, ledger, wastebasket, artist's easel, file cabinet, and a digital clock. Floating in the air is a hand with a pointing finger. Using a joystick, trackball, or "mouse" (not yet available), you can move the hand to point to any object in the room. Pressing the fire button selects that option.

For instance, pointing at the typewriter and pressing the fire button loads a typewriter-like word processing program from disk. The screen really looks like a typewriter carriage, with margin stops, paper guides, and a blank sheet of paper. You can type a document, then return to the room by pressing fire. Back at your desk, you can file the document in the cabinet, toss it in the wastebasket, or do various other things. The other options represented by objects in the room will be enabled by further programs in the *Magic Desk* series. Eventually, you'll even be able to define your own objects in the room.

Some other interesting software announcements for the 64 were six adventure games, including the popular *Zork* series; *Wizard of Wor*, the first talking game using the speech module introduced at previous shows; *Super Expander 64*, a cartridge with extended commands for graphics and sound; *Music Machine* and *Music Composer*, which use the plug-in synthesizer keyboard announced at the Winter CES; and Logo and PILOT languages on disk.

The bulk of the software seemed to be for the 64, but new VIC programs included *VICwriter*, a word processor; *SimpliCalc*, a spreadsheet; *VICfile*, a data base manager; *Know Your Child's IQ*; and *Number Nabber*, *Shape Grabber*, a teaching game for children.

On display was the previously announced portable version of the Commodore 64, known as the Executive 64 (formerly called the SX-100). The current prototype has a built-in, six-inch color monitor and disk drive, and is priced at $995. A second drive is optional. Commodore has moved the delivery date back to sometime this fall.

Not on display was a new computer announced at last summer's CES, variously known as the P Series, P128, or P-500. Intended to be a souped-up version of the Commodore 64, with 128K RAM expandable to 256K, a larger keyboard, and sleeker styling, the P was dropped without official explanation. Unofficially, Commodore wanted to concentrate on other projects. The P is being transformed into an 80-column machine without color or graphics, and will be aimed instead at the small business market. Commodore says it may be available later this year, along with the closely related B and BX Series announced last summer.

Texas Instruments

Pre-show rumors were that TI would introduce

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32K Disk	052-0175	$34.95
16K Tape	050-0175	$34.95

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one or two new computers, possibly the TI-99/4B and the TI-99/8. So much for rumors.

The 99/8, however, is said to be very near. Insiders say it will come with 80K RAM, built-in speech, and sell for roughly $500. BASIC, Forth, Logo, and UCSD Pascal will be the available languages. The 99/4B, they say, will fall somewhere between the 99/4A and 99/8 in features and price.

It could be that TI is somewhat gun-shy after its recent experience with the 99/2. Introduced at the Winter CES, the 99/2 was an economy version of the 99/4A without color or sound. It was designed to sell for $99. Unfortunately for TI, the ongoing price war with Commodore and Atari heated up a little faster than anticipated. To compete, TI slashed the price of the 99/4A again and started another rebate program. This brought the 99/4A to under $100. Unable to cut the 99/2's price accordingly, TI was forced to drop the new model it had spent months (and millions) developing. Now that each one of the Big Three has been burned in a similar way – Atari with its 1200XL and Commodore with its P128 and Max Machine – they may be more circumspect about making splashy introductions of new computers.

Although TI unveiled no new machines at CES, the company did introduce a 99/4A with a redesigned white housing. Word is the new plastic case is cheaper to manufacture, and that it will match the design of the coming 99/8.

The most interesting TI news, though, was a plug-in speech and *voice recognition* device for the 99/4A. Called the Milton Bradley MBX Expansion System, it works with ten software packages available from MB and TI. We saw it used with an educational game for children, *I'm Hiding*. Wearing a small headset with a microphone, the child names an object on the screen which might be hiding a tiny creature. The program responds to these verbal commands and even talks back with a remarkably human-like voice. The MBX will be available later this year for $129. Versions also may be adapted for other computers.

TI also introduced a 300-baud, direct-connect modem for $99; *TI-Mini-Writer*, a cassette-based word processor for $19.95; four games (*M*A*S*H*, *Sneggit*, *Moonmine*, and *Entrapment*); and six educational packages, including three games based on *E.T. the Extra-Terrestrial*.

NEC Portable Computer

The almost overnight success of Radio Shack's Model 100 portable computer seems to have caught many in the industry off guard. Watch for several similar computers to be introduced in the coming year.

The 100's sudden success also was reportedly a large factor in NEC's decision to export its version of the Model 100 to the United States. The NEC PC-8200, still being redesigned for the American market, looks almost exactly like the Model 100. This is not surprising, because NEC makes part of the Model 100 for Radio Shack. Therefore, the specifications, and even the built-in programs, are nearly identical.

NEC is departing a bit from the Model 100's design, however. Preliminary specs call for 16K RAM standard instead of 8K, expandable to 96K instead of 32K. The onboard modem found in the Model 100 may be removed, but a spreadsheet program added. The keyboard is slightly changed, with five special function keys instead of eight, and the cursor keys arranged in an efficient diamond pattern. As for pricing, NEC says only that it will be "competitive" with the Model 100. It's scheduled for delivery late this year.

Unitronics Sonic

Another interesting computer was the Unitronics "Sonic." Display models were early prototypes not yet fully functional, and this is the computer that was upgraded right at the show in response to Coleco's stunning introduction. Nevertheless, the Sonic has its own distinguishing features.

It comes with 80K of user-available RAM, plus another 16K to support its TI graphics chip. The TI chip gives the Sonic 32 sprites and 16 colors. The Sonic also has a built-in Waferdrive, a very fast mass storage device that uses Exatron Stringy Floppy technology. A wafer the size of a business card can store up to 128K. A 12K operating system and Applesoft-compatible BASIC load from one of these wafers each time the computer is switched on.

Other features: 6502 CPU chip (the same as Apple, Atari, and Commodore); upper/lowercase, 40-column screen; 70-key typewriter-style keyboard with 16 function keys; three sound channels with music synthesis; three different expansion ports, one Atari-style joystick port, and a VIC-20-compatible serial port. In addition, the Sonic will come with some software, including *Frogger*, the *Magic Window* word processor, Applesoft-compatible BASIC, the operating system, and blank wafers. Unitronics says the Sonic will be available this fall for $400.

Also planned are a Z80 Card Module to add CP/M capability, interface modules for the Atari 2600 VCS and Colecovision game machines, the Unimodem, and other peripherals and software.

Timex Computers

Timex displayed two improved versions of the Timex/Sinclair 2000 introduced at the Winter CES, plus a completely new model, the T/S 1500.

The T/S 2000 series computers are basically upgraded versions of the Sinclair ZX Spectrum, a popular machine in the United Kingdom. The

top-line T/S 2048 is a compact computer with 48K RAM and 24K ROM with BASIC; interface for standard cassette recorders; eight colors; hi-res graphics of 256 x 192 or 512 x 192; selectable 32- or 64-column screen; TV and monitor output; 10-octave sound generator; 42-key rubber "half-stroke" keyboard (not a membrane keyboard, as on the T/S 1000); one-touch BASIC keyword entry; upper/lowercase; Z80A CPU; and two joystick ports. Timex also added a slot for cartridge software and a bank-switching feature that allows addressing even more memory. Timex says the T/S 2048 will be available by fall for $199.95.

The other 2000 series computer, the T/S 2024, has all the same features except less memory: 24K RAM and 16K ROM. It costs $149.95. Both work with the T/S 2040 printer ($99.95) and ZX Spectrum cassette software. In addition, Timex is producing a line of software on cassettes and cartridges, specifically for the 2000 series, priced from $9.95 to $29.95.

The Timex/Sinclair 2048 with 48K RAM and hidden cartridge slot (beneath cover at right).

Timex's completely new computer, the T/S 1500, more closely resembles the ZX Spectrum, although it is not a color computer. It comes with 16K RAM expandable to 32K; 8K ROM with BASIC; interface for standard cassette recorders; 40-key rubber half-stroke keyboard; one-touch BASIC keyword entry; 32-column screen; programmable character sets; 22 graphics characters; and 64 x 44 graphics. The price is $79.95. An optional interface will allow the T/S 1500 to use 2000 series cartridges.

Mattel Aquarius II

Besides showing its Aquarius, Mattel revealed a sequel, the Aquarius II.

Available later this year, the Aquarius II is a more powerful computer with 20K RAM and 12K ROM. Other improvements over the Aquarius include a full-stroke, typewriter-style keyboard (without the hazardous RESET key that destroys programs) and extended Microsoft BASIC. All other features are the same as the Aquarius, except the Aquarius II is expandable to 64K RAM. It works with all Aquarius software and hardware introduced to date. Price will be in the $130-$175 neighborhood.

Mattel also displayed new accessories for its computers. The plug-in Aquarius Command Console allows computer control of household appliances and security alarms. The screen draws a cutaway picture of the house with all electrical outlets. Up to 32 devices can be controlled automatically (in seven-day cycles) or manually from the computer. The Aquarius Master Expansion Module is a large box with room for two disk drives, extra memory, two cartridges, and up to seven other peripheral boards. The Aquarius Four-Color Printer has blue, red, green, and black, and generates 40 or 80 columns on 4½-inch-wide paper. The Aquarius Phone Modem is a 300-baud device that plugs into the computer's cartridge slot. Mattel says all four products will be available later this year; prices are undetermined.

New software released for the Aquarius includes a Logo cartridge; games such as *Burgertime, Advanced Dungeons & Dragons*, and *Tron*; and home management programs such as *Finform* (a spreadsheet) and *Fileform* (a word processor).

Mattel also announced Aquarius Home Services, a data base available by modem through the CompuServe Information Service. It will have a "Hints from Heloise" column, educational games for children, SAT college-prep drills for high-schoolers, electronic mail, classified ads, and information on Aquarius computers.

Vectrex Computer

This summer's award for the most unusual computer shown at CES must go to the Vectrex Graphic Computer System. Still in early prototype stages, it consists of an add-on computer keyboard for the Vectrex game machine.

In case you're unfamiliar with the Vectrex, it's a unique game machine with its own built-in video screen. Unlike regular TV, however, the screen is a *vector-graphics* screen. TV sets use *raster-scan* screens. An example of a vector-graphics screen is the arcade version of *Asteroids*. Images are formed not with pixels, as on raster-scan displays, but with oscilloscope lines. Some unusual effects can be created this way, including simulated 3-D.

The Vectrex now sells for $99 to $129, and the computer add-on, when it becomes available, should cost around $100. It will have 16K RAM expandable to 64K, 16K ROM with BASIC, three sound channels, a 40-column by 15-line screen,

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and a 6809 CPU (as in the Radio Shack Color Computer). A Stringy Floppy drive will be optional. The BASIC has special sound commands such as NOTE, AMPLITUDE, ENVELOPE, and NOISE. A light pen introduced for the game machine also will work with the computer.

Another accessory may also work with this new computer: the new 3-D Imager. Designed for the Vectrex game machine, the 3-D Imager is a pair of heavy glasses that you wear while peering into the vector screen. One lens is blue, the other red, just like the 3-D movie glasses of the 1950s, except some kind of motorized disc spins in front of the lenses. When you look at the screen without the glasses, the vector lines appear to be vibrating. But when you look through the glasses, the lines are stable and the 3-D effect is incredible. Just imagine the games this computer could produce.

Video Technology Computers

Video Technology, which introduced the first under-$100 color computer at the Winter CES (the VZ-200), showed two new computers at this CES. Both are more advanced models:

- *Laser 2001*. Standard features are 80K RAM expandable to 144K (16K is consumed by the graphics chip); 16K ROM Microsoft BASIC; 6502A CPU; cartridge slot; rubber half-stroke, typewriter-style keyboard; user-definable keys; upper/lowercase; full-screen editing; 16 colors; two Atari-style joystick ports; 36-column text mode; 256 x 192 hi-res graphics; four sound channels; 300-baud standard cassette interface; Centronics-standard parallel port; and a rear expansion slot. Video Tech says it will be available in the United States by January for $299.
- *Laser 3000*. Standard features are 64K RAM expandable to 192K onboard; 24K ROM with Applesoft-compatible BASIC; 6502A CPU; 81-key full-stroke keyboard with numeric keypad and eight special function keys; upper/lowercase; selectable 40- or 80-column screen; hi-res graphics modes of 560 x 192 and 280 x 192; eight colors; four sound channels with six octaves; outputs for TV, composite video monitors, and RGB (Red-Green-Blue) hi-res monitors; Centronics-standard parallel interface; cassette interface; and a rear expansion slot. Video Tech says the Laser 3000 will be available by January for $699.

Optional accessories will include disk drives, a CP/M cartridge, an RS-232C interface, a modem, joysticks, and an expansion box. Video Tech is a Hong Kong-based company which exports its products to subsidiaries throughout the world.

Royal Alphatronic PC

Royal, known for its typewriters and printers, will import a Japanese-made computer to the United States this fall.

Called the Alphatronic PC, it has a Z80A CPU; 64K RAM and 32K ROM with BASIC; interfaces for Centronics-parallel, RS-232C, cassette, and system expansion; a hidden cartridge slot; CP/M compatibility; selectable 40- or 80-column screen; eight colors; an 85-key, full-stroke keyboard with numeric keypad and six special function keys; outputs for TV, composite video, and RGB monitors; and TRS-80-style line editing.

One unusual feature is a high-pitched beeper which emits a constant tone whenever you hit more than one key at a time – inevitable during fast touch-typing. The tone does not stop until you press a key in the lower-left corner of the keyboard, or else turn off the computer.

Accessories will include 320K slim-line disk drives. Royal says the Alphatronic PC will sell for $695.

Tomy Tutor

Tomy, a large toy manufacturer, introduced the "Tomy Tutor," a 16-bit home computer that can generate attractive game graphics.

The only other 16-bit home computer is the TI-99/4A. The Tutor has 16K RAM expandable to 64K; 32K ROM with extended BASIC; a rubber, half-stroke, typewriter-style keyboard; 16 colors; upper/lowercase; 256 x 192 hi-res graphics; 32-column screen; three sound generators with eight octaves each, plus a noise generator; cassette interface; TV and monitor outputs; and a cartridge slot for plug-in software. Accessories include a recorder, joysticks and controllers, a voice synthesizer, disk drive, and printer.

Tomy says the Tutor should be available this fall for under $150.

Spectra Video

At the Winter CES, Spectra Video introduced its impressive SV-318 and gave **COMPUTE!** a peek at a mock-up of their forthcoming SV-328 computer. Working models of the SV-328 finally appeared at the Summer CES.

The SV-328 should satisfy those who prefer a full-stroke, professional keyboard to the half-stroke, rubber keyboard on the SV-318. It also replaces the cursor joystick with a numeric keypad, has built-in CP/M capability, 80K of RAM expandable to 256K, and an unusually large amount of ROM, 48K expandable to 96K. Why so much ROM? Besides a super-extended Microsoft BASIC, it contains a word processor and a terminal program.

The SV-328 shares all the other SV-318 features, such as 16 colors, 32 sprites, Z80A CPU, topside cartridge slot, and three-channel, eight-octave sound. Spectra Video says the SV-328 should be available within a few months for $595.

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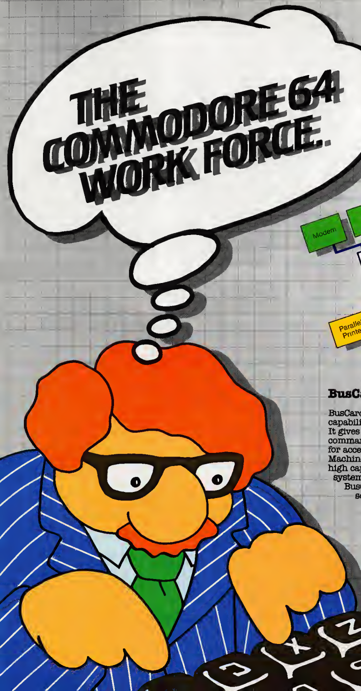
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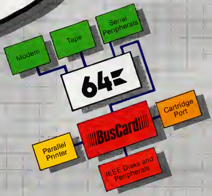
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The Predictions Of Industry Leaders

John Blackford, Assistant Features Editor

The clearest trend in the computer industry over the last few years has been its unpredictability and explosive growth. More than one company has been caught off base by falling prices, rapidly growing demand, or powerful new products – and the sight of electronics pundits eating their words has become a common one. Industry analyst Adam Osborne recently stated that a certain kind of powerful microprocessor might never be *produced – on the same day that Hewlett Packard announced one. Still, thinking about the future is essential in a field where keeping ahead is practically the key to survival, so we've asked some industry leaders about the changes they see coming this year.*

Portia Isaacson is the president of Future Computing, Inc., a firm that analyzes trends in the personal computer industry. We talked to her on the busy floor of the Summer Consumer Electronics Show (CES) among the nearly 100,000 people who flocked in to view the latest electronics wares.

Like many industry observers, Isaacson believes that this year will see a sharp increase in unit sales of home computers. But competition among hardware manufacturers has intensified. "The home computer business is in its infancy," says Isaacson, "and very violent shifts could take place." Because of the uncertainty of the hardware market, she believes software will play an increasing role. Consumer choice among contending brands will likely hinge on the quality of the software available for a given machine.

Not only games, but also more specialized software will begin to appear. "We think this is the year that educational software will take off," says Isaacson.

As software becomes more central to computer sales, companies will have to scramble to capitalize on their available programs. Major manufacturers are approaching this issue from different perspectives: Atari by selling translations of its popular games for such machines as VIC, Apple, and 64; Commodore by developing its own low-cost software; and Texas Instruments by trying to be the sole distributor of cartridge software made for its computers.

"I think Atari's decision to sell software for other machines is one of the most important strategic moves in the market this year," says Isaacson. "Atari's new computer line is also spectacular – and evolutionary." The reason, she says, is that it incorporates new features while remaining compatible with previous models, and it's designed to permit other manufacturers to develop compatible products.

Atari's willingness to support third-party development may indicate a trend that Isaacson

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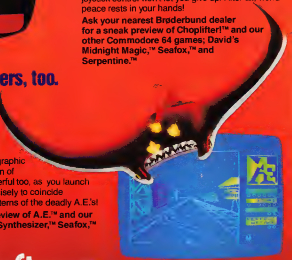

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thinks could become more pronounced in coming years – standardization of the home computer. "We think a de facto standard for home computers will be the model ultimately," she says. "IBM will enter the personal computer business with an open standard." That means other companies would be invited to follow that standard in developing their own compatible products.

The question, of course, is whose computer will become the standard. There are several strong contenders. IBM, which made an impressive showing with its personal business computer (the PC), is readying a smaller version for the home market. Atari has a strong new line, and says Isaacson, "the C-64 is absolutely compelling. I would give that every chance of surviving."

Texas Instruments has taken a somewhat different approach by discouraging others from developing cartridges compatible with its computer, even to the point of taking out advertisements in trade papers threatening legal action against those who do. Isaacson feels this could undermine support for the computer, although with profit margins on hardware so narrow, software may be the only way to stay in the game. "Manufacturers aren't making money on the product," explains Isaacson, "so they must sell software."

As home computer prices drop, more will be purchased by consumers who a year or so earlier would have bought a videogame machine. Still, because it takes time for any trend to develop, videogames are likely to remain popular in the near future. But eventually, "the merging of videogames and computers in the marketplace is now certain," says Isaacson. "You could not disagree with that after this show."

The show saw the introduction of new computer products by several companies with strong videogame lines. (For more details, see "The Fall Computer Collection: The Summer Consumer Electronics Show" in this issue.) For example, Coleco – manufacturer of the ColecoVision game machine – introduced a very inexpensive system which includes the computer, joysticks, mass storage, and printer. The game machines can be upgraded into the computer (dubbed Adam), and all Coleco game cartridges will run on the new machine.

"The Adam – Coleco's entry – is about the most unique thing in the show," adds Isaacson. "Coleco is emphasizing the utility of computers. They are saying that they have a nice little word processing package – and the videogames are an extra benefit." This approach makes the product's features easily understood by buyers. "Consumers and mass merchandisers need that simplification," she says.

John C. Cavalier is the president of Atari Products Company, a division of Atari, Inc. This division was recently reorganized to include both home computers and videogames, a fact that underscores the company's commitment to the home computer market.

"This will be the takeoff year for the computer," according to Cavalier. "Our statistics indicate that by the end of 1982, a total of two and a half million computers had been sold. In 1983 alone, seven to nine million new computers will be purchased."

Cavalier believes the computer revolution really began around 1981 and that by 1986, only five years later, at least 29 million computers will be in homes and offices throughout the United States. With roughly 60 million families now in the United States, that's getting close to one computer for half the families in the country.

In spite of the surge in computer sales, Cavalier thinks the home computer will not begin outselling game machines this year, though it may be close.

What is the significance of this explosion in computer sales? For one thing, Cavalier, like Isaacson, believes that because the competition in hardware is so fierce, manufacturers cannot depend on the computers themselves for profit. Instead, software will grow in importance as a source of revenue to computer manufacturers. "The software is where the profit is – not really hardware," he says.

Consequently, this year Atari will increase its emphasis on software sales for both the home and educational markets. In fact, notes Cavalier, Atari's recent introduction of its games for other popular computer brands – Commodore, Apple, Texas Instruments, and the IBM PC – should not undercut sales of his company's computers, but will take advantage of the popularity of some of Atari's games.

In the educational field, Atari signed an agreement with MECC, the Minnesota Educational Computer Consortium – an important source of educational programs – to offer MECC's entire

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line of software in an Atari-compatible form. This should make Atari computers more attractive to schools, some of which have favored the Apple computer because of the many educational programs available for it, including MECC's.

Although Atari is broadening its software offerings, a strong line of hardware may still be the key to attracting enough users to support the software. Atari's new computer line underscores the company's effort to move away from its image as a producer of game machines. "Until now," notes Cavalier, "I'm not sure people considered us a serious computer company."

Myrddin L. Jones is vice president of marketing for the Computer Systems Division of Commodore Business Machines, Inc. Formerly a senior vice president of marketing for North American Phillips, Jones is overseeing the sales efforts at Commodore at a time when optimism is high there.

"Systems and software is the name of the game right now," according to Jones. "Less emphasis on kilobytes and more emphasis on software is what we'll see in the coming year." Whether the applications are I.Q. development programs or home financial packages, Jones feels consumers will be increasingly aware of its possible uses when they buy a computer.

To satisfy this new consumer awareness, Commodore has recently increased development of software for its computers and released over 70 new programs. In addition, the software itself will be dropping in price. "Some of our software prices are being cut by half," notes Jones.

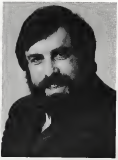
The programs that Commodore does develop will include more educational and applications software. The company has also released more than 600 educational and general-interest programs to the public domain and is offering these through retail outlets and dealers at $6.95 per disk.

"The other trend is going to be mass merchandising," says Jones. In the past, computer manufacturers haven't always been aware of the special needs of the large distributors. But in the months ahead, they are going to have to work closely with merchandisers. "Each organization can develop its package to suit its particular customer," says Jones. There will be more long-range planning, better awareness of the particulars of the mass market, and more contact between manufacturers and large distributors.

Because Commodore is vertically integrated – designing and producing many of its own chips while also doing most of its own manufacturing – Jones feels it can afford to sell its products for less than its competitors can. "I think it will be the vertically integrated companies that succeed," he says.

With this edge, Jones feels Commodore can gain 30 to 55 percent of the world market for home computers by the end of the decade. "It's warfare out there," he says, "economic warfare."

But to some extent, all manufacturers are facing low profits on hardware as the result of severe price cutting that took many companies by surprise. "People just can't afford to maintain the low profit margins," adds Jones, "so it will be a year of systems and consolidation. It has to be, because high volume alone isn't enough."



John Victor is president of Program Design, Inc. (PDI), a manufacturer of educational software and games such as Clipper: Around the Horn in 1850.

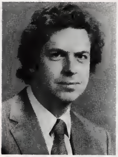
"This will be more a year of consolidation," says John Victor. "Most of the original trends were set back in 1981, and now we're seeing growth and shake-out. I don't think we will see any radical departures, but you will see intense competition and better execution on software packages."

One trend that Victor believes may accelerate this year is a move into the home market by educational software producers. "The home educational market is coming to the fore," says Victor. "The trend is to go out for the home market because schools don't have the money."

Victor's company will be introducing a series

of multimedia programs with clearly defined educational goals, supported by books, activity workbooks (for the user to fill in), and a cassette-based soundtrack under program control.

However, the market is hard to predict, and Victor is well aware that common sense cannot always be trusted in a field that has seen people succeed seemingly by doing the opposite of what appears reasonable. "If the conventional wisdom says that you shouldn't do a certain type of software, you should probably go for it."



Doug Carlston is president of Brøderbund, a producer of such popular computer games as Apple Panic *and* Choplifter.

The software market right now is maturing a little more gracefully than the hardware market, because software hasn't suffered from the severe price cutting that has affected hardware manufacturers, according to Carlston. Brøderbund, which started building its reputation with computer games, has since introduced games such as *Choplifter* that don't depend on shoot-em-up violence. Now, Brøderbund is trying to become a full-line software supplier, conforming to what Carlston sees as the trend of the marketplace.

Recently the company introduced *Bank Street Writer*, a word-processing program for children that is starting to look like a hot seller. By the end of the year, Carlston hopes to increase sales of nongame software from the current 42 percent to around 60 percent. He would also like to support a broad range of computer types, rather than provide software for only one or two brands.

"People don't understand that it's becoming a software-driven market," he says. The hardware producers are cutting prices so sharply that he sees hardly any profit left for them. Instead, Carlston thinks many of these companies will make money by selling software. Even so, he says, "lots of hardware companies will get weeded out."

Concludes Carlston, "There are a lot of major players trying to get into this game who don't realize that capital isn't enough. There's still a lot of room in this business for the individual entrepreneur."

Russ Walter, an analyst of the computer industry, authored the eight-volume Secret Guide to Computers, *now in its eleventh edition. Walter gives computer workshops in the summer at Wesleyan University in Connecticut.*

Like PDI's Victor, Walter sees a growing effort in the coming year in educational software, especially for the very young child. "There are some nice programs now for seven-year-olds. When the younger kids see them, they want something, too," says Walter.

Overall, he anticipates boom times this year, but with some manufacturers having problems because of the intense competition. "Computers are a fad this year – that means it's going to be a very good year, though the fad will wear off eventually. At the low end of the market, I'm glad that the price is really dropping – now it's under $100 for some models."

At that price, nearly anyone can afford a computer, and impulse buying becomes a factor. "The magic number was 600,000," he says. A lot of companies have sold more than that in 1983, and the year ahead promises even greater sales.

Some of the companies that Walter believes may feel the pinch in the coming months are Apple, Commodore, and Timex. Although Apple got a jump on the personal computer market, the company is now caught between lower-priced computers with similar features and the IBM Personal Computer, which has proved popular. Walter also thinks that despite its impressive price – performance features, Commodore could have trouble with the 64 if there isn't plenty of software for it by Christmas. "It remains to be seen whether the software will get generated," he adds.

Walter also believes the Timex/Sinclair 1000 – which led the way at the low end – could face a tough battle now that both the VIC-20 and TI-99/4A are selling for under $100. But the Timex/Sinclair does have some specialized applications because of its small size and sealed keyboard. "People on boats like to use it, for example," he notes.

Despite the difficulty of predicting trends in the computer market, the people we talked to were notably consistent in their observations. Most felt that price cutting on hardware had nearly eliminated computer equipment as a source of profit. Continued growth in sales coupled with tough competition and possibly a shake-out among manufacturers was a common theme. And both manufacturers and software producers agreed that software would soon be a key area for profit, with educational programs growing in importance. C

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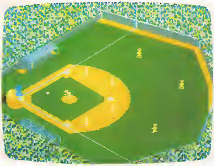

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Richard Mansfield, Senior Editor

Types Of Programs

Let's continue with our overview of the major categories of personal computer programs. The Operating System, the Disk Operating System, "utility" programs, and telecommunications programs all have several qualities in common, so we'll look at them as a group.

The Master Control Programs

In most home computers there are about 16000 memory cells set aside to hold the BASIC language and to hold the Operating System. These cells are ROM memory, which means that they cannot be erased: you can't put new information into them, and they'll hold their original information even after you turn off the power. What kind of information is in these ROMs?

BASIC generally occupies about 8000 cells (8K) and is the familiar language you use to write programs. The other 8K of ROM memory holds the Operating System (OS). This, like BASIC, is a special kind of program. You might think of it as a background program which allows the computer to coordinate its other activities (including BASIC programs).

BASIC includes many individual machine language subroutines with which the computer can add numbers, enter REMarks into a program, and most of the other actions that a computer takes while a BASIC program is RUNning. However, when a program must communicate with something outside – a disk drive, a cassette drive, a printer, or the keyboard and screen – BASIC asks for help from the OS.

Body And Mind

The Operating System's primary responsibility is to keep track of communications between the "thinking" part, the brains, of the computer and the outside world. The brains are BASIC itself and the Central Processing Unit, the chip that does all the calculations. Like BASIC, the OS is made up of many machine language subroutines. These subroutines have names like LISTEN, TALK, UNLISTEN, SCAN KEYBOARD, OPEN CHANNEL, and UNTALK. You can't use these words in a BASIC program, but whenever you PRINT, OPEN, GET, or SAVE, BASIC calls upon the OS to help coordinate and accomplish the job at hand.

It might be convenient to think of BASIC as the computer's "mind" and the OS as the "central nervous system." When your consciousness makes a decision to eat another bite of beef stew, you then turn the job over to lower, unconscious parts of your brain. That is, your nervous system takes command of the movements of your arm and guides the fork to your plate. You're watching TV or talking while your personal operating system orchestrates tasks like SCAN PLATE, OPEN MOUTH, and so forth.

Similarly, when you first wake up you're not fully conscious. Warming yourself, stretching, opening your eyes, and all the other preparations for waking are carried out in a stupor. Your nervous system is rousing itself, and your conscious mind enters the picture at the end of a series of preliminary events. Here are some of the things that the OS does in a Commodore computer when you turn it on: establishes the normal arithmetic mode; clears out a short-term memory zone; sets up communication channels with the keyboard, screen, etc.; starts the clock and clears out the sound chip; tests all of memory; and clears the screen. Then, after the OS has finished – it all takes about a second – control is turned over to BASIC.

The Disk Unconscious

The job performed by a disk drive – it's a high-speed, automatic library – is so complex that the "intelligence" required to operate it can rival the brains of the host computer. What the OS is to the computer, the Disk Operating System (DOS) is to the disk drive. It performs all the routine chores of storage, retrieval, and organizing of the programs or pure information (data, like an address file) on disks. The internal subroutines of DOS have names like ALLOCATE BLOCK, UPDATE BLOCK MAP, FIND CHANNEL, and

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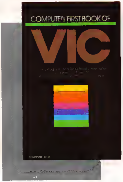

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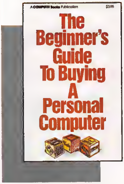

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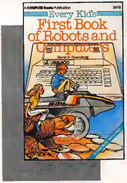

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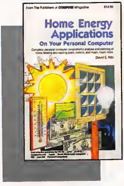

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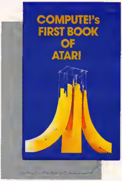

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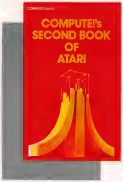

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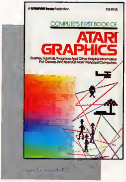

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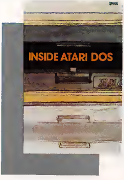

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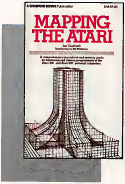

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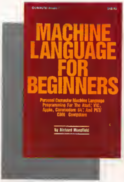

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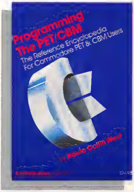

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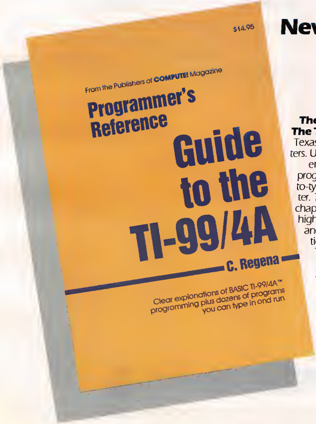

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MATCH FILE. Your request to LOAD a program from disk can go to BASIC, then to the OS, then to the DOS. Each does its part.

Where is DOS located? In some computers (Atari, Apple), the DOS program must first be loaded into the computer (using up some RAM memory) before you can communicate with the disk drive. An alternative used by TI and Commodore, among others, is called *distributed intelligence*. All the elements of a true computer are in the disk drive: RAM and ROM memory, a CPU, and associated computing chips. One of the advantages to having a DOS which is separate from the main computer is that you can send instructions to the disk drive such as INITIALIZE (prepare a blank disk to receive new information). If the drive is an "intelligent peripheral," it will then work merrily away under its own supervision and your computer is free to accept other, unrelated instructions at the same time.

By the way, if you've recently purchased a 1541 disk drive for your VIC or 64, don't be confused by the name of the "DOS 5.1" program. It's not the DOS, it's a *utility program* which makes it easier for you to communicate with the true DOS.

Programmers' Bag Of Tricks

Utilities are programs that help you write programs. Most versions of BASIC lack some of the tools which would contribute to efficient programming. Utilities can be loaded in from tape or disk and perform a valuable function. Examples include: renumber, mass-delete, automatic line numbering, list all variables, merge two programs, repeating keys, bidirectional scrolling, trace (the active BASIC lines appear onscreen during a program's execution), and various graphics and sound commands.

Utilities are often grouped together and sold commercially. Alternatively, **COMPUTE!** and *COMPUTE!'s Gazette* publish several utilities every month. Watch upcoming issues for a program for the Commodore 64 called "BASIC AID" which includes all the utilities mentioned above in addition to 22 others.

The Brainless Computer

One of the most promising and fastest-growing areas of personal computing is telecommunications. Connect your computer to a telephone and you can then communicate with large data bases (information storage facilities), more powerful computers, and news and information services. Your computer can become an extension of far larger systems. What happens is that your own RAM and ROM can be bypassed in favor of the greater computing power available to you when you're in contact with a huge computing system located somewhere else. Its stored knowledge,

speed, and its connections with *other* huge systems all become available to you. Your own computer acts simply as a keyboard/TV combination, a "brainless" unit sometimes referred to as a *dumb terminal*. If some of your RAM or ROM are being used, it would be called a *smart terminal* since some of the actual computing is going on at your end.

In either configuration, you telecommunicate by attaching a box called a *modem* to your computer; that makes the connection between your machine and the phone. The program which handles the communication is often called a *terminal emulator* and is usually included when you buy a modem. ©

Weather Forecaster

George W Miller

This program enables you to make quite accurate local weather predictions. Written for the T/S 1000 with 16K, versions are included for computers with Microsoft and modifications for Commodore, Apple, and the Color Computer.

The National Weather Service uses computers when forecasting the weather, so why not use your home computer for your own local forecast?

You will need some easily obtainable data. Since you don't have access to a network of reporting stations or satellites orbiting the earth, about the best device available is a barometer. Everyone knows a falling barometer means bad weather is approaching, but this information coupled with wind direction, will allow you to make a fairly accurate local forecast.

If you're able to interface with the outside world, you could even have a dedicated weather forecasting machine which can update the forecast as often as you like and provide a continuous monitor of changing weather conditions. However, our concern here is to demonstrate how you can forecast the weather with very little effort and a great deal of accuracy.

You will need a barometer, available at most hardware stores, and ideally some device to indicate wind direction, such as a weather vane. A less accurate, but still effective method is to use a compass and observe the wind yourself.

One word of warning. This is a very long program and will fill 16K RAM on the Timex/Sinclair. SAVE it often while you are making your entries. It can be very frustrating to lose the program after several hours work due to a glitch.

This program is based on very simple, but sound scientific facts. In the Northern Hemisphere, winds blow counterclockwise around a low pressure system, and clockwise around a high pressure system. So, if you stand outside, with the wind at your back, a low pressure system will be on your left. If the barometer is falling, this low is heading in your direction.

The wind direction and barometric pressure, combined with scientific observation, indicate what weather changes to expect. Your T/S 1000 can figure this out for you in a matter of seconds, and the program will even tell you what the normal weather for the month is.

You'll have to make a visit to the local library for information on your local weather conditions, but we'll get to that in a minute.

Let's take a look at the T/S version of the program. First you'll notice a list of variables in lines 5 through 56. Enter them from the listing, *except* for line 10, which should read:

```
10 DIM A$(1,31)
```

This will allow enough room in memory to make the necessary entries in the later portions of the program. We'll change this to a larger DIMension before we're finished.

Line 59 will GOSUB 2000, which displays the title block and gives some preliminary instructions.

After displaying the title and instructions, line 2075 advises us to "PRESS ANY KEY TO CONTINUE". There is no input statement following, only the command PAUSE 40000. The way ROM is organized, any number following PAUSE that is greater than 32,767 causes the program to halt and wait for any key to be pressed. Pressing any key causes the program to drop through to line 2085. We're using the pause this way so that any user has a chance to read the mes-

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sage completely.

Line 2090 RETURNs us to the main program at line 60, and lines 60 to 95 print the menu.

Optional Extras

If you want to dress up your program a little, use the graphics mode to print the inverse form of the letter for each command, but be sure to use the regular mode for the letters in lines 105 to 125 to satisfy the argument for Y$. Otherwise, you'll find the menu becomes clumsy as you must shift to the graphics mode for every command entry.

The menu offers a lot. For example, you can store data in RAM, generate a weather forecast, display the data you have stored, display normal conditions for your area, STOP the program, search for a specific date, and make corrections.

Now we're ready to begin working on our data file. Line 143 checks to see if there is any room left in the file. If L = 190, you have stored data for 190 days in the file, and any additional data will generate an error. When you do reach this point, SAVE the data and program on tape if you want to refer to it later, or just enter RUN. RUN will clear all of your variables, and you can start over. To use your data file in this program you must start the program by entering GOTO 59.

The raw data is stored in string variables, in this case A$(X), with all the data held in one variable. A$ is a two-dimensional array, which will be 190 entries long, and will hold 31 characters in each entry. A$(X,1 TO 2) holds the number of the month; A$(X,3 TO 4) holds the number of the day; and A$(X,5 TO 6) holds the year.

High and low temperatures are entered as four characters, such as +076. In order to avoid the necessity of right justifying, each entry *must* have four characters. High temperature for each entry is stored in A$(X,7 TO 10) and the low temperature is stored in A$(X, 11 TO 14).

The barometric pressure is stored in A$(X,15 TO 19) as five characters, for example, 30.18.

Notes To Weather Forecaster
(Microsoft Version)

Patrick Parrish, Programming Assistant

The Microsoft Version (Program 2) of Weather Forecaster will run with minor modifications on the 64, all PETs (40- or 80-column screens) with at least 16K of memory, the Color Computer, and the Apple. Programs 3, 4, and 5 are the necessary data storage routines to be typed in with Program 2 depending on which computer you have.

Commodore

If you are programming the 64 or 32K PET (you can try it with a 16K VIC, but you'll need to reformat the display for 22 columns), type in Programs 2 and 3. With the 16K PET, DIMension A$ in line 100 to 150 rather than 365. Each day of weather data is stored in A$(I), so with the 16K PET, you will only have enough memory to store data corresponding to 150 days under one file name.

Program 3 is written to accommodate either a disk or cassette data file. The subroutine within Program 3 beginning at line 3100 is used to detect disk errors. When a disk error is encountered, line 3103 will display four parameters: error number, error description, track accessed, and sector accessed. If a disk error does occur and you can resolve it, return to the main program menu by typing:

```
GOTO 110
```

To avoid a "file not found" error, be sure that you have previously saved the data file before you attempt to recall it.

TRS-80 Color Computer

If you have a Color Computer with at least 16K, you will need to make three changes to Program 2. First, replace PRINT"{CLR}" with CLS in lines 17 and 2010. Also, DIMension A$ in line 100 to 150. Of course, this reserves space in memory for only 150 days of data. You may vary this limit depending on the memory available. You can use another weather file when you exceed the limit.

Program 4 is the data storage routine for the Color Computer. Type it in along with Program 2. Program 4 only lets you save or load the weather data to or from cassette. If you own a disk drive, you can easily modify this routine by reading about data files in your disk drive manual.

Apple II / Apple II Plus

If you are using an Apple, Program 2 should be typed in with the data storage routine (Program 5). Two changes are necessary in Program 2. Lines 17 and 2010 should read HOME rather than PRINT"{CLR}".

Program 5 is the data storage routine for use with the Apple disk drive. It contains a disk error trapping routine (line 3200) giving you the disk error number and the line in the program where it has occurred. If a disk error occurs that you can correct, return to the main program and re-SAVE the data so that no data is lost.

General weather conditions are entered into A$(X,20) from the following table:

1=FAIR
2=CLOUDY
3=RAIN
4=SNOW
5=THUNDERSHOWERS
6=SNOW FLURRIES
7=HEAVY RAIN

Line 235 prompts for precipitation amounts. This must be a five-character entry (such as 02.75), and is stored in A$(X,21 TO 25).

Snowfall amounts are two characters stored in A$(X,26 TO 27).

Wind direction is stored in A$(X,28 TO 31) as a four-character entry with the first two characters being the wind direction from the following table:

01=N	05=S
02=NE	06=SW
03=E	07=W
04=SE	08=NW

The last two characters are wind speed and are entered as part of the code called for in line 285. Your entry would look like "0705" for a wind from the west at 5 miles per hour.

Lines 300 to 350 print out your data entries and ask if all is correct. If an error is found, line 360 restarts the entry process at line 135.

Lines 355-740 contain more inputs, calculations, and the forecasting results of your input. Line 750 returns to the main menu.

You'll have to determine the average temperatures, rainfall, and snowfall amounts for your area. A good source of this information is *The Weather Almanac*, edited by James A. Ruffner and Frank E. Bair, published by Avon Books. It's available from most libraries. Look up the city nearest you and make your substitutions in lines 940 to 1025.

The subroutine starting in line 3000 allows you to check the weather conditions on any day in your file. You enter the date in question, and the computer searches for that date. If the date is in memory, lines 3066 to 4000 will display the information.

When it's necessary to make a correction, lines 5005 to 6010 find the date in question and prompt for the correct information. Line 6005 assigns the value of N to X, and the information you've just entered is placed into the file in place of the incorrect information.

Now go back to line 10. Change your statement to DIM A$(190,31) and enter RUN to establish and reserve space in RAM for your file. From now on, be sure to start your program with a GOTO 59, *not* RUN. RUN clears all variables, so you'll lose your file in RAM.

The program takes about 7 minutes to load from tape and it will use all 16K. If any changes are necessary, go back and change line 10. You must first delete the entry, enter RUN, and then make whatever changes are needed.

Program 1: Weather Forecaster – Timex/Sinclair Version

(*Note:* Underlined characters should be typed in inverse video.)

```
1 REM "WX"
2 REM DO NOT USE "RUN" - USE GOTO 59
5 LET X=0
6 LET A=0
7 LET B=0
8 LET C=0
9 LET L=0
10 DIM A$(190,31)
15 DIM B$(1,8)
20 DIM C$(1,4)
25 DIM D$(1,4)
30 DIM E$(1,5)
35 DIM F$(1,1)
40 DIM G$(1,5)
45 DIM H$(1,3)
50 DIM I$(1,4)
55 DIM J$(1,31)
56 DIM K$(1)
59 GOSUB 2000
60 CLS
65 PRINT AT 0,5;"WEATHER ANALYSIS "
70 PRINT
75 PRINT AT 5,3;"UPDATE DATA ENTER U "
80 PRINT AT 7,3;"FORECAST FROM DATA ENTE
   R F "
85 PRINT AT 9,3;"DISPLAY DATA ENTER D "
90 PRINT AT 11,3;"DISPLAY NORMALS ENTER
   N "
92 PRINT AT 13,3;"TO STOP ENTER S "
93 PRINT AT 15,3;"SEARCH DATE ENTER C "
94 PRINT AT 17,3;"CORRECTIONS ENTER M "
95 PRINT AT 20,0;"FUNCTION???"
100 INPUT Y$
105 IF Y$="U" THEN GOTO 135
110 IF Y$="F" THEN GOTO 380
115 IF Y$="D" THEN GOTO 700
120 IF Y$="N" THEN GOTO 900
122 IF Y$="C"THEN GOTO 3000
123 IF Y$="M" THEN GOTO 5000
125 IF Y$="S"THEN STOP
130 GOTO 95
135 CLS
140 PRINT"{11 SPACES}DATA UPDATE"
143 IF L=190 THEN PRINT"FILE FULL"
144 IF L=190 THEN PAUSE 40000
145 IF L=190 THEN GOTO 60
146 PRINT
150 PRINT"ENTER DATE (AS 12-30-82):"
155 INPUT B$(1,1 TO 8)
158 LET L=L+1
160 FOR X=L TO 190
165 LET A$(X,1 TO 2)=B$(1,1 TO 2)
170 LET A$(X,3 TO 4)=B$(1,4 TO 5)
172 LET A$(X,5 TO 6)=B$(1,7 TO 8)
175 PRINT"ENTER HIGH TEMPERATURE (AS +076)"
180 INPUT C$(1,1 TO 4)
185 LET A$(X,7 TO 10)=C$(1,1 TO 4)
190 PRINT"ENTER LOW TEMPERATURE (AS -006)"
195 INPUT D$(1,1 TO 4)
200 LET A$(X,11 TO 14)=D$(1,1 TO 4)
```

```
205 PRINT"ENTER BAROMETER (IN INCHES)"
210 INPUT E$(1,1 TO 5)
215 LET A$(X,15 TO 19)=E$(1,1 TO 5)
220 PRINT"ENTER GENERAL WEATHER CONDITIO
    N",,"1=FAIR",,"2=CLOUDY",,"3=RAIN"
223 PRINT,"4=SNOW",,"5=THUNDERSHOWERS",
    "6=SNOW FLURRIES",,"7=HEAVY RAIN"
225 INPUT F$(1,1)
230 LET A$(X,20)=F$(1,1)
235 PRINT"ENTER PRECIPITATION (INCHES)"
240 PRINT"AS: Ø2.75"
245 INPUT G$(1,1 TO 5)
248 LET A$(X,21 TO 25)=G$(1,1 TO 5)
250 PRINT"SNOWFALL AMOUNT (AS Ø7)"
255 INPUT H$(1,1 TO 2)
258 LET A$(X,26 TO 27)=H$(1,1 TO 2)
260 CLS
265 PRINT"ENTER WIND DIRECTION AND SPEED
    :"
270 PRINT"USE THIS CODE:","Ø1=N",,"Ø2=NE
    ",,"Ø3=E",,"Ø4=SE",,"Ø5=S",,"Ø6=SW"
273 PRINT,"Ø7=W",,"Ø8=NW"
275 PRINT
280 PRINT"ENTER DIRECTION AND SPEED","AS
     FOUR DIGIT NUMBER ""Ø312"""
285 INPUT I$(1,1 TO 4)
290 LET A$(X,28 TO 31)=I$(1,1 TO 4)
295 CLS
300 PRINT"DATE: ";A$(X,1 TO 6)
305 PRINT"HI TEMP: ";A$(X,7 TO 10)
310 PRINT"LO TEMP: ";A$(X,11 TO 14)
315 PRINT"BAROMETER: ";A$(X,15 TO 19)
320 PRINT"CONDITIONS: ";A$(X,20)
330 PRINT"PRECIPITATION: ";A$(X,21 TO 25
    )
335 PRINT"SNOWFALL: ";A$(X,26 TO 27)
340 PRINT"WINDS: ";A$(X,28 TO 31)
342 PRINT"USE THIS CODE:","Ø1=N",,"Ø2=NE
    ",,"Ø3=E",,"Ø4=SE",,"Ø5=S",,"Ø6=SW"
343 PRINT,"Ø7=W",,"Ø8=NW"
345 PRINT
350 PRINT"ISTHISCORRECT?"

355 INPUT Z$
360 IF Z$="N" THEN GOTO 135
365 LET L=X
370 IF Z$="Y" THEN CLS
375 IF X$="Y" THEN GOTO 65
380 CLS
385 PRINT"{8 SPACES}FORECAST"
390 PRINT"ENTER BAROMETRIC PRESSURE:"
395 INPUT A
400 PRINT
405 PRINT"IS BAROMETER: ","1. STEADY",,"
    2. SLOW RISE",,"3. RAPID RISE"
406 PRINT ,"4. SLOW FALL",,"5. RAPID FAL
    L"
407 PRINT"RAPID CHANGE IS ANY CHANGE ","
    IN EXCESS OF Ø.Ø6 PER HOUR."
410 INPUT B
415 PRINT
420 PRINT"WIND FROM:"
425 PRINT,"1=N",,"2=NE",,"3=E",,"4=SE",,
    "5=S",,"6=SW",,"7=W",,"8=NW"
430 INPUT C
433 CLS
435 IF A>=30.2 AND B=4 AND C>=6 AND C<=8
     THEN GOTO 625
440 IF A>=30.2 AND B=1 AND C>=6 AND C<=8
     THEN GOTO 620
445 IF A>=30.1 AND B=1 AND C>=6 AND C<=8
     THEN GOTO 600
450 IF A>=30.1 AND B=3 AND C>=6 AND C<=8
     THEN GOTO 605
455 IF A>=30.1 AND B=4 AND C>=6 AND C<=8
     THEN GOTO 610
460 IF A>=30.1 AND B=5 AND C>=6 AND C<=8
     THEN GOTO 615
465 IF A>=30.1 AND B=4 AND (C=4 OR C=5)
    THEN GOTO 630
470 IF A>=30.1 AND B=5 AND (C=4 OR C=5)
    THEN GOTO 635
475 IF A>=30.1 AND B=4 AND C>=2 AND C<=4
     THEN GOTO 640
480 IF A>=30.1 AND B=5 AND C>=2 AND C<=4
     THEN GOTO 645
485 IF A>=30.1 AND B=4 AND (C=3 OR C=2)
    THEN GOTO 650
490 IF A>=30.1 AND B=5 AND (C=3 OR C=2)
    THEN GOTO 655
492 IF A<=29.8 AND B=5 AND C>=1 AND C<=3
     THEN GOTO 680
493 IF A<=29.8 AND B=5 AND C>=3 AND C<=5
     THEN GOTO 675
494 IF A<=29.8 AND B=3 THEN GOTO 685
495 IF A<=30.1 AND B=4 AND C<=4 AND C>=2
     THEN GOTO 660
500 IF A<=30.1 AND B=5 AND C<=4 AND C>=2
     THEN GOTO 665
505 IF A<=30.1 AND B=2 AND (C=5 OR C=6)
    THEN GOTO 670
600 PRINT "FAIR, LITTLE CHANGE IN TEMP",
    "FOR NEXT DAY OR TWO."
601 PAUSE 40000
602 GOTO 60
605 PRINT "FAIR TODAY, RAINY AND WARMER"
    ,"WITHIN 48 HOURS"
606 PAUSE 40000
607 GOTO 60
610 PRINT "WARMER, RAIN WITHIN 18 TO 24"
    ,"HOURS"
616 PAUSE 40000
617 GOTO 60
620 PRINT "CONTINUED FAIR WITH LITTLE","
    OR NO CHANGE IN TEMPERATURE"
621 PAUSE 40000
622 GOTO 60
625 PRINT "FAIR AND WARMER FOR NEXT 48 H
    OURS"
626 PAUSE 40000
627 GOTO 60
630 PRINT "RAIN WITHIN 24 HOURS"
631 PAUSE 40000
632 GOTO 60
635 PRINT "WINDY, WITH RAIN WITHIN 12","
    TO 24 HOURS"
636 PAUSE 40000
637 GOTO 60
640 PRINT "RAIN IN 12 TO 18 HOURS"
641 PAUSE 40000
642 GOTO 60
645 PRINT "WINDY AND RAIN WITHIN 12 HOURS"
646 PAUSE 40000
647 GOTO 60
650 PRINT "IN SUMMER WITH LIGHT WINDS: "
    ,"RAIN MAY NOT FALL FOR SEVERAL","DA
    YS"
651 PRINT "IN WINTER: RAIN WITHIN 24 HOU
    RS"
```

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```
652 PAUSE 40000
653 GOTO 60
655 PRINT "IN SUMMER RAIN LIKELY WITHIN"
    ,"12 TO 24 HOURS"
656 PRINT "IN WINTER: RAIN OR SNOW WITH
    INCREASING WINDS"
657 PAUSE 40000
658 GOTO 60
660 PRINT "RAIN FOR NEXT DAY OR TWO"
661 PAUSE 40000
662 GOTO 60
665 PRINT "RAIN, WITH HIGH WINDS FOLLOWE
    D","WITHIN 24 HOURS BY CLEARING "
666 PRINT "AND TURNING COLDER"
667 PAUSE 40000
668 GOTO 60
670 PRINT "CLEARING WITHIN A FEW HOURS,"
    ,"FAIR FOR NEXT SEVERAL DAYS"
671 PAUSE 40000
672 GOTO 60
675 PRINT "SEVERE STORM WARNING","WINDY,
     WITH RAIN OR SNOW IMMINENT"
676 PRINT "FOLLOWED WITHIN 24 HOURS BY",
    "CLEARING AND COLDER"
677 PAUSE 40000
678 GOTO 60
680 PRINT "SEVERE STORM WARNING","SEVERE
     NORTHEAST GALES"
681 PRINT "HEAVY RAIN OR SNOW, FOLLOWED
    IN WINTER BY A COLD WAVE"
682 PAUSE 40000
683 GOTO 60
685 PRINT "CLEARING AND COLDER"
686 PAUSE 40000
687 GOTO 60
700 CLS
705 FOR T=1 TO L
706 SCROLL
710 PRINT A$(T)
720 SCROLL
730 NEXT T
740 PAUSE 200
750 GOTO 60
900 CLS
905 PRINT "{6 SPACES}WEATHER NORMS"
925 PRINT
930 PRINT "{6 SPACES}TEMP
935 PRINT "{2 SPACES}HI LO MO{2 SPACES}R
    AIN{3 SPACES}SNOW"
940 PRINT "J 38 23 30{3 SPACES}2.83
    {4 SPACES}9.1"
945 PRINT "F 41 24 32{3 SPACES}2.70
    {4 SPACES}9.6"
950 PRINT "M 51 31 41{3 SPACES}3.19
    {4 SPACES}6.5"
955 PRINT "A 64 42 53{3 SPACES}3.02
    {4 SPACES}0.3"
960 PRINT "M 75 52 63{3 SPACES}3.61
    {4 SPACES}0.0"
965 PRINT "J 83 61 72{3 SPACES}3.61
    {4 SPACES}0.0"
970 PRINT
975 PRINT "J 87 65 76{3 SPACES}3.61
    {4 SPACES}0.0"
980 PRINT "A 85 63 74{3 SPACES}3.76
    {4 SPACES}0.0"
985 PRINT "S 78 56 67{3 SPACES}3.21
    {4 SPACES}0.0"
990 PRINT "O 67 45 56{3 SPACES}2.82
    {4 SPACES}0.1"
995 PRINT "N 53 35 44{3 SPACES}2.66
    {4 SPACES}2.1"
1000 PRINT "D 40 25 33{3 SPACES}2.94
    {4 SPACES}7.7"
1005 PRINT
1010 PRINT "YR 63 43 53 37.96"
1015 PRINT
1020 PRINT "DATA FROM NWS HBG.,PA."
1025 PRINT "{11 SPACES}ELEVATION 338 FT.
    "
1030 PAUSE 40000
1040 GOTO 60
2000 CLS
2001 FOR I=1 TO 10
2002 PRINT
2003 NEXT I
2005 PRINT "{8 SPACES}WEATHER ANALYSIS "
2040 PAUSE 400
2050 CLS
2055 PRINT "THIS PROGRAM IS DESIGNED TO"
    ,"STORE A LIMITED AMOUNT OF DATA"
2056 PRINT "IN THE FILE PORTION OF THE",
    "PROGRAM. IT IS SUGGESTED"
2057 PRINT "THAT FOR STORAGE OF MORE THA
    N ","SIX MONTHES A WEATHER FILE BE"
2058 PRINT "MAINTAINED."
2060 PRINT
2065 PRINT "THIS PROGRAM WILL OFFER A","
    FORECAST OF EXPECTED LOCAL"
2066 PRINT "WEATHER CONDITIONS, USING","
    BAROMETRIC PRESSURE AND WIND"
2067 PRINT "DIRECTION",,,,"YOU WILL BE S
    URPRISED AT"
2068 PRINT "THE ACCURACY OF THIS METHOD,
    ","YET IT IS BASED ON SOUND"
2069 PRINT "SCIENTIFIC PRINCIPLES."
2070 PRINT
2075 PRINT "PRESS ANY KEY TO CONTINUE"
2080 PAUSE 40000
2085 CLS
2090 RETURN
3000 CLS
3010 PRINT "ENTER DATE (AS 12-05-82)"
3015 INPUT B$(1,1 TO 8)
3018 FAST
3020 LET C$(1,1 TO 2)=B$(1,1 TO 2)
3025 LET C$(1,3 TO 4)=B$(1,4 TO 5)
3030 FOR A=1 TO L
3035 IF C$(1,1 TO 4)=A$(A,1 TO 4) THEN G
    OTO 3050
3040 NEXT A
3042 SLOW
3045 PRINT "DATE NOT FOUND"
3046 PAUSE 40000
3047 GOTO 60
3050 CLS
3055 SLOW
3066 PRINT "DATE: ";A$(A,1 TO 6)
3070 PRINT "HI TEMP: ";A$(A,7 TO 10)
3075 PRINT "LO TEMP: ";A$(A,11 TO 14)
3080 PRINT "BAROMETER: ";A$(A,15 TO 19)
3085 PRINT "CONDITION: ";A$(A,20)
3090 PRINT "PRECIPITATION: ";A$(A,21 TO
    25)
```

```
3Ø95 PRINT "SNOWFALL: ";A$(A,26 TO 27)
4ØØØ PRINT "WINDS: ";A$(A,28 TO 31)
4Ø1Ø PAUSE 4ØØØØ
4Ø2Ø GOTO 6Ø
5ØØØ CLS
5ØØ5 PRINT "ENTER DATE TO CHANGE:"
5Ø1Ø INPUT B$(1,1 TO 8)
5Ø11 LET C$(1,1 TO 2)=B$(1,1 TO 2)
5Ø12 LET C$(1,3 TO 4)=B$(1,4 TO 5)
5Ø15 FAST
5Ø2Ø FOR N=1 TO L
5Ø25 IF A$(N,1 TO 4)=C$(1,1 TO 4) THEN G
     OTO 51ØØ
5Ø3Ø NEXT N
5Ø4Ø SLOW
5Ø5Ø PRINT "DATE NOT IN FILE"
5Ø55 PAUSE 4ØØØØ
5Ø6Ø GOTO 6Ø
51ØØ CLS
511Ø PRINT "ENTER: "
512Ø PRINT TAB 5;"DATE (AS 6 DIGITS)","
     {9 SPACES}(12Ø582)"
5125 INPUT A$(N,1 TO 6)
513Ø PRINT TAB 5;"HI TEMP"
5135 INPUT A$(N,7 TO 1Ø)
514Ø PRINT TAB 5;"LOW TEMP"
5145 INPUT A$(N,11 TO 14)"
515Ø PRINT TAB 5;"BAROMETER"
5155 INPUT A$(N,15 TO 19)"
516Ø PRINT TAB 5;"CONDITION"
5165 PRINT ,"1. FAIR",,"2. CLOUDY",,"3.
     RAIN",,"4. SNOW",,"5. THUNDERSHOWER
     S"
5167 PRINT ,"6. SNOW FLURRIES","7. HEAVY
      RAIN"
517Ø INPUT A$(N,2Ø)
5175 PRINT TAB 5;"RAIN"
518Ø INPUT A$(N,21 TO 25)
5185 PRINT TA8 5;"WINDS"
519Ø INPUT A$(N,28 TO 31)
5195 PRINT TAB 5;"SNOWFALL"
6ØØØ INPUT A$(N,26 TO 27)
6ØØ5 LET X=N
6ØØ7 CLS
6Ø1Ø GOTO 3ØØ
```

Program 2:

Weather Forecaster — Microsoft Version

```
5 GOTO 1ØØ
7 GOSUB17
8 FORI=1TO4:PRINT:NEXTI:PRINTTAB(3);:RET
  URN
1Ø PRINT P$;:INPUT B$:IF B$="" THEN 11Ø
12 IFLEN(B$)<>BTHENPRINT"RE-ENTER":FORI=
   1TO2ØØ:NEXTI:PRINTP$;:INPUTB$
15 RETURN
17 PRINT"{CLR}":REM ON APPLE, LINE 17 IS
   -17 HOME, ON CC-17 CLS
18 RETURN
2Ø A$(L)=A$(L)+B$:RETURN
1ØØ DIM A$(365):GOSUB 2ØØØ
1Ø5 REM NOTE:DIMENSION A$(19Ø) OR LESS F
    OR 16K COLOR COMPUTER IN LINE 1ØØ
11Ø GOSUB 17
112 PRINTTA8(8)"WEATHER ANALYSIS"
115 PRINT:PRINT:PRINTTAB(4)"TO LOAD DATA
    :{2 SPACES}ENTER L"
12Ø PRINTTAB(4)"UPDATE DATA: ENTER U"
13Ø PRINTTAB(4)"FORECAST FROM DATA: ENTE
    R F"
14Ø PRINTTAB(4)"DISPLAY DATA: ENTER D"
15Ø PRINTTAB(4)"DISPLAY NORMALS: ENTER N
    "
16Ø PRINTTAB(4)"TO MEMORIZE: ENTER M"
17Ø PRINTTAB(4)"SEARCH DATA: ENTER S"
18Ø PRINTTAB(4)"CORRECTIONS: ENTER C"
19Ø PRINTTAB(4)"TO QUIT: ENTER Q"
2ØØ PRINT:INPUT"CHOICE ";Y$
221 IF Y$="U" THEN 25Ø
222 IF Y$="F" THEN 4ØØ
223 IF Y$="D" THEN 7ØØ
224 IF Y$="N" THEN 9ØØ
225 IF Y$="S" THEN 125Ø
226 IF Y$="C" THEN 15ØØ
227 IF Y$="M" OR Y$="L" THEN 3ØØØ
228 IF Y$="Q" THEN 26ØØ
23Ø GOTO 2ØØ
25Ø GOSUB 17
255 PRINTTAB(11)"DATA UPDATE"
257 PRINT"ENTER:"
26Ø L=L+1
27Ø PRINT:P$="DATE (AS Ø1-Ø5-83):":B=8:G
    OSUB 1Ø
275 A$(L)=LEFT$(B$,2)+MID$(B$,4,2)+RIGHT
    $(8$,2)
285 P$="HI TEMP (AS +Ø76):":B=4:GOSUB 1Ø
    :GOSUB 2Ø
29Ø P$="LOW TEMP (AS -ØØ6):":GOSUB 1Ø:GO
    SUB 2Ø
295 P$="BARO. PRES (AS 3Ø.15):":B=5:GOSU
    B 1Ø:GOSUB 2Ø
3ØØ PRINT:PRINT"GENERAL WEATHER CONDITIO
    NS:":PRINT"1= FAIR";
3Ø5 PRINTTAB(18)"2= CLOUDY":PRINT"3= RAI
    N";TAB(18)"4= SNOW"
31Ø PRINT"5= THUNDERSHOWERS";TAB(18)"6=
    FLURRIES"
315 PRINT"7= HEAVY RAIN"
32Ø P$="":B=1:GOSUB1Ø:GOSUB2Ø
325 PRINT:P$="PRECIP(INCHES-AS Ø2.75)":
    B=5:GOSUB1Ø:GOSUB2Ø
33Ø GOSUB 17
335 PRINT"ENTER:":PRINT:P$="SNOWFALL AMT
     (AS Ø7):":B=2:GOSUB1Ø:GOSUB2Ø
346 PRINT:PRINT"FOR WIND DIRECTION AND S
    PEED,"
35Ø PRINT"USE THIS CODE:":PRINT"Ø1=N"TAB
    (12)"Ø2=NE"TAB(24)"Ø3=E"
355 PRINT"Ø4=SE"TAB(12)"Ø5=S"TAB(24)"Ø6=
    SW":PRINT"Ø7=W"TAB(12)"Ø8=NW"
36Ø PRINT:PRINT"ENTER DIRECTION AND SPEE
    D AS A 4"
362 P$="DIGIT NUMBER-AS Ø312:":8=4:GOSU8
    1Ø:GOSUB2Ø
365 GOSUB 17
366 PRINT:PRINT"DATE: ";LEFT$(A$(L),6):P
    RINT"HI TEMP: ";MID$(A$(L),7,4)
37Ø PRINT"LOW TEMP: ";MID$(A$(L),11,4)
372 PRINT"BAROMETRIC PRESSURE: ";MID$(A$
    (L),15,5)
375 PRINT"CONDITIONS: ";MID$(A$(L),2Ø,1)
376 PRINT"PRECIPITATION: ";MID$(A$(L),21
    ,5)
38Ø PRINT"SNOWFALL: ";MID$(A$(L),26,2):P
    RINT"WINDS: ";MID$(A$(L),28,4)
385 PRINTTAB(3)"RECALL THE CODE: ":PRINT
    "Ø1=N"TAB(8)"Ø2=NE"TAB(16)"Ø3=E";
386 PRINTTAB(24)"Ø4=SE":PRINT"Ø5=S"TAB(8
    )"Ø6=SW"TAB(16)"Ø7=W"TAB(24)"Ø8=NW"
```

```
387 IF D=1 THEN RETURN
390 PRINT:INPUT"IS THIS CORRECT (Y/N) ";
    B$:IF B$="N" THEN 270
392 IF C=1 THEN RETURN
395 GOTO11Ø
400 GOSUB 17
401 PRINTTAB(12)"FORECAST":PRINT:PRINT"E
    NTER:"
405 PRINT:INPUT"BAROMETRIC PRESSURE: ";A
    $:A=VAL(A$)
406 IF A$="" THEN 11Ø
410 PRINT:PRINT:PRINT"IS BAROMETER ?":PR
    INT"1.STEADY"TAB(16)"2.SLOW RISE"
411 PRINT"3.RAPID RISE"TAB(16)"4.SLOW FA
    LL":PRINT"5.RAPID FALL"
412 PRINT:PRINT"(RAPID CHANGE IS ANY CHA
    NGE IN"
413 PRINT"EXCESS OF Ø.Ø6 PER HOUR.)":INP
    UTB$:B=VAL(B$):IFB$=""THEN 11Ø
417 GOSUB17:PRINT"WIND FROM: ?":PRINT"1=
    N","2=NE","3=E":PRINT"4=SE","5=S",
418 PRINT"6=SW":PRINT"7=W","8=NW"
425 INPUT C$:C=VAL(C$):IF C$=""
    {2 SPACES}THEN 11Ø
430 IFA>=3Ø.2ANDB=4ANDC>=6ANDC<=8THEN625
440 IFA>=3Ø.2ANDB=1ANDC>=6ANDC<=8THEN62Ø
445 IFA>=3Ø.1ANDB=1ANDC>=6ANDC<=8THEN6ØØ
450 IFA>=3Ø.1ANDB=3ANDC>=6ANDC<=8THEN6Ø5
455 IFA>=3Ø.1ANDB=4ANDC>=6ANDC<=8THEN61Ø
460 IFA>=3Ø.1ANDB=5ANDC>=6ANDC<=8THEN615
465 IFA>=3Ø.1ANDB=4AND(C=4ORC=5)THEN63Ø
470 IFA>=3Ø.1ANDB=5AND(C=4ORC=5)THEN635
475 IFA>=3Ø.1AND B=4ANDC>=2ANDC<=4THEN64
    Ø
480 IF A>=3Ø.1ANDB=5ANDC>=2ANDC<=4THEN64
    5
485 IFA>=3Ø.1ANDB=4AND(C=2ORC=3)THEN65Ø
490 IFA>=3Ø.1ANDB=5AND(C=2ORC=3)THEN655
492 IFA<=29.8ANDB=5ANDC>=1ANDC<=3THEN68Ø
493 IFA<=29.8ANDB=5ANDC>=3ANDC<=5THEN675
494 IF A<=29.8ANDB=3THEN 685
495 IFA<=3Ø.1ANDB=4ANDC>=2ANDC<=4THEN66Ø
500 IFA<=3Ø.1ANDB=5ANDC>=2ANDC<=4THEN665
505 IFA<=3Ø.1ANDB=2AND(C=5ORC=6)THEN67Ø
600 GOSUB7:PRINT"FAIR, LITTLE CHANGE IN
    TEMP":PRINT"FOR NEXT DAY OR ";
601 PRINT"TWO.":GOTO 69Ø
605 GOSUB7:PRINT"FAIR TODAY, RAINY AND W
    ARMER":PRINT"WITHIN 48 HOURS.":GOTO6
    9Ø
610 GOSUB7:PRINT"WARMER, RAIN WITHIN 24
    TO 36":PRINT"HOURS.":GOTO69Ø
615 GOSUB7:PRINT"WARMER, RAIN WITHIN 18
    TO 24":PRINT"HOURS.":GOTO69Ø
620 GOSUB7:PRINT"CONTINUED FAIR WITH LIT
    TLE OR"
621 PRINT"NO CHANGE IN TEMPERATURE.":GOT
    O69Ø
625 GOSUB7:PRINT"FAIR AND WARMER FOR NEX
    T 48":PRINT"HOURS.":GOTO 69Ø
630 GOSUB7:PRINTTAB(3)"RAIN WITHIN 24 HO
    URS.":GOTO 69Ø
635 GOSUB7:PRINT"WINDY, WITH RAIN WITHIN
     12 TO":PRINT"24 HOURS.":GOTO69Ø
640 GOSUB7:PRINTTAB(3)"RAIN IN 12 TO 18
    HOURS.":GOTO 69Ø
645 GOSUB7:PRINT"WINDY AND RAIN WITHIN 1
    2 HRS.":GOTO 69Ø
650 GOSUB7:PRINT"IN SUMMER WITH LIGHT WI
    NDS:":PRINT"RAIN MAY NOT FALL FOR ";
651 PRINT"DAYS.":PRINT:PRINT"IN WINTER:
    RAIN WITHIN 24 HOURS.":GOTO 69Ø
655 GOSUB7:PRINT"IN SUMMER: RAIN LIKELY
    WITHIN":PRINT"12 TO 24 HOURS."
656 PRINT:PRINTTAB(4)"IN WINTER: RAIN OR
     SNOW WITH":PRINT"INCREASING WINDS."
657 GOTO 69Ø
660 GOSUB7:PRINTTAB(3)"RAIN FOR NEXT DAY
     OR TWO.":GOTO 69Ø
665 GOSUB7:PRINT"RAIN WITH HIGH WINDS FO
    LLOWED":PRINT"WITHIN 24 HOURS BY ";
666 PRINT"CLEARING AND":PRINT"COOLER TEM
    PERATURES.":GOTO69Ø
670 GOSUB7:PRINT"CLEARING WITHIN A FEW
    {2 SPACES}HOURS.":PRINT"FAIR FOR NEX
    T SEVERAL";
671 PRINT" DAYS.":GOTO69Ø
675 GOSUB7:PRINT"SEVERE STORM WARNING.
    {2 SPACES}WINDY, ":PRINT"WITH RAIN O
    R SNOW ";
676 PRINT"IMMINENT FOL-":PRINT"LOWED WIT
    HIN 24 HRS BY CLEARING"
677 PRINT"AND COLDER.":GOTO69Ø
680 IF A>=3Ø.1ANDB=5ANDC>=2ANDC<=4THEN64
    5
681 PRINT"HEAVY RAIN OR":PRINT"SNOW FOLL
    OWED IN WINTER BY A":PRINT"COLD WAVE
    ."
682 GOTO69Ø
685 GOSUB 7:PRINTTAB(8)"CLEARING AND COL
    DER."
690 FORI=1 TO6:PRINT:NEXTI:GOSUB 25ØØ:GO
    TO 11Ø
700 GOSUB 17
701 D=1:IF L=ØTHEN 7Ø8
703 X=L:FORI=1TOX:L=I:GOSUB365:PRINT:INP
    UT"INPUT C TO CONTINUE ";C$
705 IF C$<>"C" THEN I=X
706 PRINT:NEXTI:L=X:D=Ø:GOTO11Ø
708 D=Ø:PRINT"NO DATA FOUND.":FORT=1TO2Ø
    ØØ:NEXTT:GOTO11Ø
900 GOSUB 17
902 PRINT:PRINTTAB(9)"WEATHER NORMS"
905 PRINT:PRINTTAB(4)"TEMP"
910 PRINTTAB(2)"HI LO MO{2 SPACES}RAIN
    {3 SPACES}SNOW"
915 PRINT:PRINT"J 38 23 3Ø{2 SPACES}2.83
    {3 SPACES}9.1":PRINT"F 41 24 32
    {2 SPACES}2.7Ø{3 SPACES}9.6"
920 PRINT"M 51 31 41{2 SPACES}3.19
    {3 SPACES}6.5":PRINT"A 64 42 53
    {2 SPACES}3.Ø2{3 SPACES}Ø.3"
930 PRINT"M 75 52 63{2 SPACES}3.61
    {3 SPACES}Ø.Ø":PRINT"J 83 61 72
    {2 SPACES}3.61{3 SPACES}Ø.Ø"
935 PRINT:PRINT:INPUT"INPUT C FOR REST O
    F YEAR";C$:GOSUB 17
937 PRINTTAB(2)"HI LO MO{2 SPACES}RAIN
    {3 SPACES}SNOW"
940 PRINT:PRINT"J 87 65 76{2 SPACES}3.61
    {3 SPACES}Ø.Ø":PRINT"A 85 63 74
    {2 SPACES}3.76{3 SPACES}Ø.Ø"
950 PRINT"S 78 56 67{2 SPACES}3.21
    {3 SPACES}Ø.Ø":PRINT"O 67 45 56
    {2 SPACES}2.82{3 SPACES}Ø.1"
955 PRINT"N 53 35 44{2 SPACES}2.66
    {3 SPACES}2.1":PRINT"D 4Ø 25 33
    {2 SPACES}2.94{3 SPACES}7.7"
960 PRINT:PRINT"YR 63 43 53 37.96 35.4"
970 PRINT:PRINTTAB(2)"DATA FROM NWS HBG.
```

```
      ,P.A.":PRINTTAB(2)"ELEVATION 338 FT.
      "
980 PRINT:GOSUB 2500:GOTO 110
1250 GOSUB 17
1251 PRINT:PRINTTAB(8)"SEARCH DATE":D=1
1260 PRINT:PRINT:PRINT"ENTER DATE TO FIN
     D:":P$="(AS 01-05-83) "
1265 B=8:GOSUB10:C$=LEFT$(B$,2)+MID$(B$,
     4,2)
1270 X=L:FORI=1TOL:IFC$=LEFT$(A$(I),4)TH
     ENFL=1:T=I:I=L:NEXTI:L=T:GOSUB365:D
     =0
1273 IF FL=1 THENFL=0:L=X:GOSUB2500:GOTO
     110
1275 NEXT I:PRINT:PRINT"DATE NOT FOUND":
     GOTO 690
1500 GOSUB 17
1505 PRINTTAB(11)"CORRECTIONS":C=1
1510 PRINT"ENTER DATE TO CHANGE:":P$="(A
     S 01-05-83) "
1512 B=8:GOSUB10:C$=LEFT$(B$,2)+MID$(B$,
     4,2)
1570 X=L:FORI=1TOL:IFC$=LEFT$(A$(I),4)TH
     ENFL=1:T=I:I=L:NEXTI:L=T:GOSUB275
1571 IF FL=1 THEN FL=0:L=X:GOSUB2500:GOT
     O110
1575 NEXTI:PRINT:PRINT"DATE NOT IN FILE"
     :GOTO690
2000 GOSUB 17
2005 FORI=1TO8:PRINT:NEXTI:PRINTTAB(8)"W
     EATHER ANALYSIS":FORI=1TO1000:NEXTI
2010 PRINT"{CLR}":REM APPLE-2010 HOME, O
     N CC-2010 CLS
2020 PRINTTAB(4)"THIS PROGRAM IS DESIGNE
     D TO"
2030 PRINT"STORE ON DISK OR TAPE A YEAR'
     S":PRINT"WORTH OF DATA IN THE FILE"
     ;
2035 PRINT" EN-":PRINT"TITLED 'WEATHER F
     ILE'. IT IS"
2037 PRINT"SUGGESTED THAT FOR STORAGE OF
     ":PRINT"MORE THAN ONE YEAR OF DATA,
      A"
2040 PRINT"SEPARATE WEATHER RECORD BE MA
     IN-":PRINT"TAINED."
2055 PRINT:PRINTTAB(4)"THIS PROGRAM WILL
      OFFER A "
2060 PRINT"FORECAST OF EXPECTED WEATHER"
     :PRINT"CONDITIONS USING BAROMETRIC"
2100 PRINT"PRESSURE AND WIND DIRECTION."
2130 PRINT:GOSUB2500:RETURN
2500 INPUT"{3 SPACES}INPUT C TO CONTINUE
     ";C$:RETURN
2600 GOSUB 17:FORI=1TO9:PRINT:NEXTI:PRIN
     T"HAS THE DATA BEEN"
2610 INPUT"MEMORIZED (Y/N)";H$:IFH$="N"T
     HEN110
2620 END
2999 REM BE SURE TO INCLUDE PROG 3,4, OR
      5 AS NEEDED BEGINNING AT LINE 3000
```

Program 3:
64 And PET (40 or 80 column) Data Storage Routine

```
3000 REM C64, PET(40 OR 80 COLUMN) CASSE
     TTE AND DISK FILE HANDLING ROUTINE
3002 PRINT"{CLR}":FORI=1TO4:PRINT:NEXTI:
     INPUT"DISK OR CASSETTE (D/C) ";E$
3004 IFE$<>"D"ANDE$<>"C"THEN3002
3005 IFE$="D"THEN3020
3010 F$="WEATHER FILE":D1=0:G$="":GOTO30
     40
3020 F$="@0:WEATHER FILE":D1=1
3040 IFY$="M"THEN3080
3050 IFD1=1THENG$=",S,R"
3060 OPEN1,1+7*D1,8*D1,F$+G$:GOSUB3100
3070 INPUT#1,L:FORI=1TOL:INPUT#1,A$(I):N
     EXTI:GOSUB3100:CLOSE1:GOSUB3100:GOT
     O110
3080 IFD1=1THENG$=",S,W"
3085 OPEN1,1+7*D1,1+7*D1,F$+G$:GOSUB 310
     0
3090 PRINT#1,L:FORI=1TOL:PRINT#1,A$(I):N
     EXTI:GOSUB3100:CLOSE1:GOSUB3100:GOT
     O110
3100 IF O=0 THEN OPEN 15,8,15:O=1
3103 INPUT#15,A,B$,C,D:IF A THEN PRINT A
     ,B$,C,D:STOP
3110 RETURN
```

Program 4:
Color Computer Data Storage Routine

```
3000 REM COLOR COMPUTER CASSETTE LO
     AD AND SAVE ROUTINE
3010 PRINT"PLACE WEATHER FILE TAPE
     IN":PRINT"THE RECORDER AND REW
     IND."
3020 IF Y$="L" THEN 3070
3030 PRINT:PRINT"PRESS RECORD AND P
     LAY":INPUT"PRESS <ENTER> WHEN
     READY";C$
3040 OPEN"O",#-1,"WEATHER FILE"
3050 PRINT #-1,L:FORI=1TOL:PRINT #-
     1,A$(I):NEXTI
3060 CLOSE #-1:GOTO110
3070 PRINT:PRINT"PRESS PLAY, PLEASE
     "
3080 INPUT"PRESS <ENTER> WHEN READY
     ";C$
3090 OPEN"I", #-1,"WEATHER FILE"
3100 INPUT #-1,L:FORI=1TOL:INPUT #-
     1,A$(I):NEXT I
3110 CLOSE #-1:GOTO110
```

Program 5:
Apple Data Storage Routine

```
3000  REM  APPLE DISK SAVE OR LOAD
3010  HOME : PRINT
3015  ONERR  GOTO 3200
3020 D$ =  CHR$ (4)
3022  PRINT D$;"OPEN WEATHER FILE": IF
     Y$ = "M" THEN 3040
3024  PRINT D$;"READ WEATHER FILE"
3026  INPUT L: FOR I = 1 TO L: INPUT A$
     (I): NEXT I
3030  GOTO 3060
3040  PRINT D$;"WRITE WEATHER FILE"
3050  PRINT L: FOR I = 1 TO L: PRINT A$
     (I): NEXT I
3060  PRINT D$;"CLOSE WEATHER FILE": POKE
     216,0: GOTO 110
3200  HOME : VTAB 5: PRINT "ERROR # "; PEEK
     (222);" OCCURRED AT LINE "; PEEK (
     219) * 256 +  PEEK (218)
3210  VTAB 10: PRINT "HINT: HAVE YOU PR
     EVIOUSLY SAVED THE": PRINT "DATA F
     ILE TO DISK?"
3220  PRINT D$;"CLOSE WEATHER FILE": GOTO
     690
```

©

Questions Beginners Ask

Tom R Halfhill, Features Editor

Are you thinking about buying a computer for the first time, but don't know anything about computers? Or maybe you just purchased a computer and are still a bit baffled. Each month in this column, **COMPUTE!** *will tackle some questions commonly asked by beginners.*

Q **I keep seeing printers and computers advertised with features such as "full ASCII character set" or "ASCII keyboard," etc. What does ASCII mean?**

A ASCII stands for "American Standard Code for Information Interchange." Basically, it's a way of encoding characters (letters, numbers, punctuation, special symbols) into standardized numbers that can be understood by any computer or computer device. ASCII was invented to allow all types of computers, terminals, keyboards, printers, modems, disk drives, and other peripherals to easily communicate with each other. It's like the "Morse code" for computing.

The "ASCII character set" is a table of all the letters, numbers, punctuation marks, and other symbols that any computing device might need to communicate with another. Each character in the ASCII table is represented by a number ranging from 0 to 127. For instance, the ASCII code number for the letter "A" is 65; the code for the number "0" is 48; the code for an exclamation mark ("!") is 33. (Many computer manuals and books have an appendix with a table of the ASCII codes.)

When a computer sends something to be printed on a printer, for example, the characters are converted to ASCII numbers by the computer, transmitted along the printer cable, and then recognized by the printer as the original characters. Thus, when a printer is advertised as having a "full ASCII character set," it means the printer is capable of recognizing and printing any standard ASCII character.

Likewise, a "standard ASCII keyboard" means that the computer or terminal keyboard can type any ASCII character. This is especially important for computers or terminals that will be used for telecomputing (hooking up to distant computers over telephone lines). Some of the ASCII codes are "control codes" – they transmit a command encoded as a character. For example, the ASCII code "7" stands for "bell." It rings a built-in bell or buzzer found on most computers and terminals. ASCII code "13" means "carriage return" and is like pressing the RETURN or ENTER key on the keyboard.

The subject of character codes can become very complicated, because even computers which have ASCII keyboards and which communicate with outside devices in ASCII do not necessarily use ASCII internally.

Atari computers, for example, use ASCII for letters and punctuation, but deviate from ASCII for the control codes – such as 155 for carriage return (versus 13 in true ASCII) and 253 for the bell, as opposed to ASCII's 7.

Commodore computers send control characters as ASCII, but the codes for the lowercase alphabet (normally 97-112) are offset by 64. This can cause problems when you try to hook up a standard ASCII printer (usually upper- and lowercase come out reversed).

Apple computers use true ASCII and can even send lowercase, although you can't display lowercase on an unmodified Apple II. Both the Texas Instruments TI-99/4A and the TRS-80 Color Computer use true ASCII.

Any computer can be made to send and receive true ASCII with a hardware or software interface. That's one of the functions of "terminal software" in telecomputing: a special program translates the computer's output to universal ASCII.

Q **What exactly is a "port," as in "user port," or "serial port," or "input/output port"?**

A A "port" is simply a slot or a jack on a computer where external devices may be plugged in. It's similar to the jacks on a stereo receiver which allow you to add on speakers, tape decks, turntables, and other accessories.

There are many different types of ports, and often they are incompatible among different computers. That's one reason why you can't plug an Apple disk drive directly into a Commodore 64, or an Atari cassette recorder into a VIC-20.

However, some standards have been established for ports, at least unofficially. The two main types of input/output ports are known as "serial" and "parallel." In personal computing, the prevailing standard for serial ports is the "RS-232C" interface; for parallel ports, it's the "Centronics" interface. Most computers have one or sometimes both of these ports. Those which do not, require an additional adapter or interface box to make them compatible with the wide range of external devices designed to work with these interfaces.

The "user port" on Commodore 64 and VIC-20 computers can be used as both a serial and a parallel port for input/output. As a serial port, it fits almost all of the RS-232C standards. As a parallel port, it does not conform to the Centronics standard, but can be used for similar purposes.

Another type of port familiar to home computerists is the joystick port. The Atari-type joystick port seems to have become the de facto industry standard. It is found on the Atari 2600 VCS game machine, the Atari 400/800/1200XL computers, the Commodore 64 and VIC-20, and several other home computers introduced within the past year. Although most commonly used as an input port (joysticks, paddles, and light pens), this controller port also is capable of output. Some Atari users even wire two of their joystick ports together to make a parallel port for a printer. ©

Part II

Constructing The Ideal Computer Game

Orson Scott Card, Editor, COMPUTE! Books

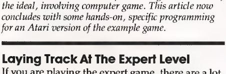
Last month, in Part I, we explored the general notion of the ideal, involving computer game. This article now concludes with some hands-on, specific programming for an Atari version of the example game.

Laying Track At The Expert Level

If you are playing the expert game, there are a lot of track-laying options open to you, for you are allowed to create switches.

Simple Switches. To create switches, *hold down the joystick button* when you push or pull the joystick. You will get the following results.

If, with the button held down, you push the joystick in the direction that would normally lay a straight track unit, a Y-switch will be laid:



push right **push straight ahead** **pull toward you**

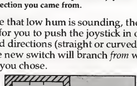
If, with the button held down, you push the joystick in the direction that would normally curve the track to one side or the other, one spur of the switch will go straight ahead, while the other spur will curve in the direction you pushed.

push right **push straight ahead** **pull toward you**

Laying Complex Switches. The most complicated switching operation is when you want the track to branch *from* another direction. If, with the button held down, you push the joystick back in the direction you came from, which would normally let you re-lay the last track unit, a low hum comes from the television.

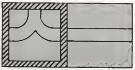
Push the button and then push the joystick back in the direction you came from.

While that low hum is sounding, the program will wait for you to push the joystick in one of the three valid directions (straight or curved to either side). The new switch will branch *from* whatever direction you chose.



push straight ahead

Now a high-pitched sound will come from the television. This means that the program is waiting for you to choose one of the two remaining valid directions. The switch will branch *toward* the direction you choose.



push left

GO WITH THE WINNER

If you wanted to bet on the horses, you'd get advice from somebody who'd been a success at betting on the horses.

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APPLE II** REQUIREMENTS: DOS 3.3, 48K RAM, disk drive, 40-character display.
OSBORNE I™ REQUIREMENTS: Standard Osborne I package.
ATARI** 400/800/1200 REQUIREMENTS: 48K RAM and one disk drive.
*Display shows actual photograph of IBM PC version. Apple and Atari calar graphics and Osborne monochrome graphics are similar. Versions for TRS-80** and ather brands will be available shortly.*

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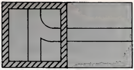


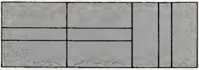
pull toward you

The high-pitched sound will end. You can then change your mind, of course, and lay a different switch or a simple track unit – nothing is definite until you push START. But while those tones are sounding, you can choose only valid switching options, until you have completed the switch.

As you can see, there are only three possible switches – a left switch, a right switch, and a Y-switch. All switch units are laid by pressing down the button while moving the joystick. Only when you want a switch to branch *from* another direction does it take more than one step to lay a switch unit.

This sounds harder, and it is – but it also gives you more freedom when you come to track you have already laid. You still can do only crossovers and curved bypasses of the other player's track, but you can now *join* the spur you are working on to another segment of your own track.

For instance, say you are laying a unit of track in the square shown below.



new track **your old track**

At the beginner level, you could lay only a straight unit, creating a crossover. But at the expert level, you can also choose a left curve or a right curve, which would create one of the following switches:

left curve **right curve**

Please notice that you don't have to push a button to create one of these switches. In fact, the program will ignore the button if you are about to cross an existing track segment, for each switch can only branch into two spurs.

illegal switches

This means that every switch that creates a new spur must end with a switch that rejoins the spur to the main line.

To keep things from getting too cluttered in your layout, you can create a total of only eight switch-pairs if you are playing alone, or four switch-pairs for each player in a two-player game. So if you try to push the button to create a ninth (or fifth) switch, the program will ignore the button.

Play Options

How can you tell a spur from the main line? The only difference is the way the spur *ends*. If the spur ends by joining directly to the beginning of the very first track unit laid, it is the main line. If the spur ends by creating a switch to join it to any track segment, then that spur is *not* the main line.

"Railroader" keeps track of how many spurs there are, and will not let you join the last spur back to the main line with a switch, unless you have already joined the main line back to the first track unit. And if you press OPTION with any spurs left open, without being joined back to the main line, Railroader will automatically make one spur the main line by joining it to the first track segment, and then will join all the other spurs to the nearest segment of the main line by using switches.

• *Choosing Which Spur to Build On.* When you have more than one spur, of course, you get to decide *which* spur you are adding to. You do this by pressing the SELECT button at the beginning of your turn. Railroader remembers the location of every uncompleted spur end, and each time you press SELECT the cursor moves from one spur end to the next. Even if you have already laid a track unit in that turn, but have not yet pressed START, you can press SELECT and Railroader will erase the unit you just laid, then move the cursor square to the end of the next uncompleted spur.

• *Crossovers and Bypasses.* Just because you *can* join one track to another with switches at the expert level doesn't mean you have to. You can still create a crossover or curving bypass by pushing the joystick in the direction that would normally lay those track units.

• *Erasing with Switches.* What about erasing track units by pushing the joystick back in the

direction you came from? You can still do that, but when you come to a switch, Railroader will not let you erase it until you have erased all of *both* spurs leading away from that switch. When you have erased all of one spur, up to the switch, then push SELECT until you are at the uncompleted end of the other spur, and erase that line of track up to the switch. Now Railroader will let you erase the switch. (*Notice*, though, that this works only if the spur has not been completed. If you come to a switch whose other end is already joined to the main line, pushing SELECT won't get you to the uncompleted end of that spur, since it *has* no uncompleted end.)

• *Illegal Moves*. Now that you can use switches to join onto existing lines of track, there are fewer illegal moves to worry about, right? Unfortunately, it isn't so. You *still* can't join your spur to the other player's track. And now you can't cross over or bypass any track unit that contains a switch, either your own or the other player's! This means that you will end up erasing more often, as you or the other player occasionally get one of your spurs in a box.

• *Ending the Expert-level Session*. Just push OPTION. If you left any loose ends, Railroader will clean them up, just as in the beginning level. If you left a spur in a box, however, from which Railroader can't legally escape without erasing, the program will put the cursor at the uncompleted end of that spur, so you can erase that line of track back to a point where either you or Railroader can legally complete the spur.

Running The Trains

When you end your track-laying session (or if you chose "Run Trains" instead of "Lay Track" at the beginning of the game), Railroader will ask you whether you want to use the layout you just created or load one from cassette or diskette. If you choose diskette, you will be asked the file name.

When Railroader saves a layout, the file that holds the data also remembers whether there was one player or two. When you decide to run trains on a layout, you do not get to choose one or two players – Railroader will run two trains if there are two tracks, one train if there is only one track.

If there is only one train, it is twice as long as each of the trains in a two-player game. (Since two trains use up twice as much CPU time as one train, this makes it so that one- and two-train games run at the same speed.) You cannot stop or speed up, but you can *slow down* your train by holding down your joystick button. When you let go, the train immediately resumes normal speed.

You can control the switches with your joystick. Of course, if the spur you are on is merely joining onto another line, with no choice of direction, you have no choice. But if your train could go either way, Railroader remembers whether you last pushed your joystick left or right. Other directions are ignored. If you last pushed left, your train will take the left-hand track at every switch it comes to until you push right. It doesn't matter *when* you push the joystick, except that once your engine has passed the switch, Railroader will not change that switch; instead, the program will assume you have changed the *next* switch.

Of course, if the train layout you are playing on was created at the beginner level, there are no switches. There will probably be crossovers and bypasses, however, which will make running the train more interesting.

Two-Player Scoring

If there are two players, Railroader keeps a score. You get one point for each track unit you pass through (which encourages you to stay at top speed); two points for each switch you cross over, and ten points if your opponent crashes into you. (You get no points for crashing into your opponent.) Only relative scores are kept – the difference between your scores. Your engines change color, depending on which of you is ahead. The leader has a brighter, warmer-colored engine; the other player has a darker engine, in cooler colors. The actual number of the difference in scores between the two players is not displayed until the end. This means that when you are playing noncompetitively, or with young children, they do not have to be aware of "winning" or "losing" – the color changes can be purely decorative.

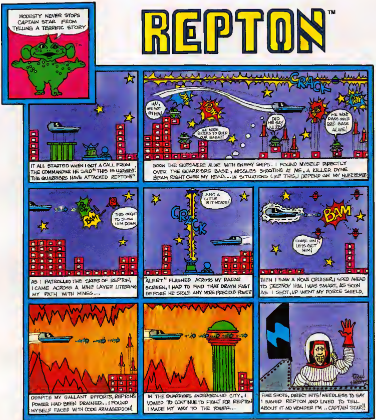
The game ends when one player or the other pushes OPTION, or when the difference between the two players is greater than 255.

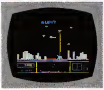
Programming Hints: Creating The Screen

The easiest way to create the train layout is to use an alternate character set with a multicolor character mode, if your computer will allow it, though direct pixel manipulation will also work. On the Atari, for instance, you would probably use ANTIC mode 4, which provides a screen 24 characters high and 40 characters wide (just like Graphics 0). You might then divide the screen into four-character by four-character blocks, giving you a grid of six blocks vertically by ten blocks horizontally. (Any arrangement that comes out even will do.) Obviously, these blocks correspond to the "square" track units.

Individual characters might look like the seven characters depicted in Figure 1.

These characters might be combined into an up-right curving block of track as shown in Figure 2.


MODESTY NEVER STOPS CAPTAIN STAR FROM TELLING A TERRIFIC STORY
REPTON™
IT ALL STARTED WHEN I GOT A CALL FROM THE COMMANDER HE SAID "THIS IS URGENT! THE QUARRIORS HAVE ATTACKED REPTON!!"
CRACK
HA!, WE GOT BY HIM!
POW
HA! MORE BRICKS TO BUILD OUR BASE!!
DID HE SAY NUKE?
ZAP
POP
HE WON'T PASS OVER OUR BASE ALIVE!
SOON THE SKIES WERE ALIVE WITH ENEMY SHIPS. I FOUND MYSELF DIRECTLY OVER THE QUARRIORS BASE, MISSLES SHOOTING AT ME, A KILLER DYNE BEAM RIGHT OVER MY HEAD...IN SITUATIONS LIKE THIS, I DEPEND ON MY NUKE BOMB
POW
BAM
THIS OUGHT TO SLOW HIM DOWN
AS I PATROLLED THE SKIES OF REPTON, I CAME ACROSS A MINE LAYER LITTERING MY PATH WITH MINES...
JUST A LITTLE BIT MORE!
CRACK
"ALERT" FLASHED ACROSS MY RADAR SCREEN, I HAD TO FIND THAT DRAYN FAST BEFORE HE STOLE ANY MORE PRECIOUS POWER
BAM
COME ON!, LETS GET HIM!
THEN I SAW A NOVA CRUISER, I SPED AHEAD TO DESTROY HIM. I WAS SMART, AS SOON AS I SHOT, UP WENT MY FORCE SHIELD.
DESPITE MY GALLANT EFFORTS, REPTONS POWER HAD BEEN DRAINED...I FOUND MYSELF FACED WITH CODE ARMAGEDDON!
IN THE QUARRIORS UNDERGROUND CITY, I VOWED TO CONTINUE TO FIGHT FOR REPTON I MADE MY WAY TO THE TOWER...
FIVE SHOTS, DIRECT HITS! NEEDLESS TO SAY I SAVED REPTON AND LIVED TO TELL ABOUT IT NO WONDER I'M ..CAPTAIN STAR!!




Sirius™
presents
REPTON

Figure 1. Seven Multicolor Characters

CHAR 1

00	01	11	01
00	00	11	00
00	01	11	01
00	00	11	00
00	01	11	01
00	00	11	00
00	01	11	01
00	00	11	00

Left half of vertical straight track

CHAR 2

01	11	01	00
00	11	00	00
01	11	01	00
00	11	00	00
01	11	01	00
00	11	00	00
01	11	01	00
00	11	00	00

Right half of vertical straight track

CHAR 3

00	00	00	00
00	00	00	00
00	00	00	00
00	00	00	00
00	01	00	01
11	11	11	11
00	01	00	01
00	01	00	01

Top of horizontal straight track

CHAR 4

00	01	00	01
00	01	00	01
11	11	11	11
00	01	00	01
00	00	00	00
00	00	00	00
00	00	00	00
00	00	00	00

Bottom of horizontal straight track

CHAR 5

00	00	01	00
00	00	00	01
00	01	00	11
00	00	01	11
00	00	11	01
00	00	11	00
00	01	11	01
00	00	11	00

Left side of up-right curve

CHAR 6

00	00	00	00
00	00	00	00
00	00	00	00
00	00	00	00
00	00	00	01
00	00	11	11
01	11	00	01
11	01	00	01

Top of up-right curve

CHAR 7

11	01	00	00
11	00	01	00
01	00	00	01
00	01	00	11
00	00	01	11
01	00	11	01
00	01	11	00
00	11	01	00

Inside of up-right curve

You might notice that the four corners of every block are never used, and depending on the track layout within each block, many other characters are blank. You could fill these blank spaces with almost anything. In fact, since the place where the corners of four blocks join will always be blank, you might put buildings, foliage, water, or practically anything into these spaces before the game begins, giving a sense of the space remaining to be filled.

How Many Characters Will It Take?

Surprisingly few characters will be needed to create the track itself. On the Atari, for instance, if the rails are drawn using color register 2 at location 710, then the second player's track can use the same characters, but entered in inverse mode. In inverse mode, the color of the rails will come from color register 3 at location 711.

There are two possible straight tracks: vertical and horizontal. Each requires two characters. The four possible curves (up-left, up-right, down-left, and down-right) require 12 more characters. There are 12 switches – four Y-switches, four left-hand switches, and four right-hand switches – but they might be able to use some pieces from the curves and straight tracks, so that only 32 new characters would be needed to make them. Bypasses and crossovers require another eight characters.

That means that 68 characters are required to make every essential track element – leaving you 60 characters for drawing buildings, foliage, ponds, or anything else you might want to add.

Putting Together The Blocks

How many total blocks would you need? For one player, you would need two straightaways, four curves, one crossover, two bypasses, four Y-switches, four left-hand switches, and four right-hand switches. For two players, double that and add six new blocks for situations where two different-colored tracks are present on the same block (two crossovers and four bypasses). That gives you a total of 48 blocks, each consisting of 16 characters.

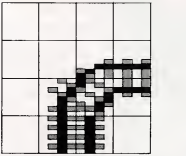
Blocks could be stored as a two-dimensional or three-dimensional numeric array, and your program could POKE them into screen memory:

```
500 FOR I=0 TO 3
510 FOR J=0 TO 3
520 POKE SCREEN+PLACE+(40*I)+J,BLOCK
    (UPLEFT,I,J)
530 NEXT J:NEXT I:RETURN
```

In this subroutine, BLOCK is a three-dimensional

Figure 2.

Block Of 16 Characters Forming An Up-Right Curve



array, in which the first subscript defines which block it is, the second defines the row of the block, and the third defines the character on the row. The characters in Block 7 would be defined like this:

```
BLOCK(7,0,0) BLOCK(7,0,1) BLOCK(7,0,2) BLOCK(7,0,3)
BLOCK(7,1,0) BLOCK(7,1,1) BLOCK(7,1,2) BLOCK(7,1,3)
BLOCK(7,2,0) BLOCK(7,2,1) BLOCK(7,2,2) BLOCK(7,2,3)
BLOCK(7,3,0) BLOCK(7,3,1) BLOCK(7,3,2) BLOCK(7,3,3)
```

ULEFT is the variable holding the number of the block that draws an up-left curve. SCREEN holds the address of the start of screen memory. PLACE holds the offset of the block's starting address from SCREEN: 40 is added to PLACE for each new line, and 1 for each new character.

The same sort of thing could be done with string arrays, using POSITION and PRINT commands:

```
500 FOR I=0 TO 3
510 POSITION COLUMN,LINE+I
520 PRINT BLOCK$(ULEFT,I)
530 NEXT I:RETURN
```

Atari users could dimension one long string – DIM BLOCK$(767) – and then use POSITION and PRINT commands like this:

```
500 FOR I=0 TO 3
510 POSITION COLUMN,LINE+I
520 PRINT BLOCK$(ULEFT+(I*4),ULEFT+(I*4)+3)
530 NEXT I:RETURN
```

You don't have to settle for the 24-row by 40-column screen, either. Even with coarse scrolling, instant vertical wraparound can be achieved by making the last 24 rows of screen memory identical with the first 24 rows, and then page-flipping instead of scrolling at the very top and bottom of screen memory. As players lay track at the top or bottom of the screen, they might notice a slight delay as the program POKEs the blocks into two places in screen memory instead of one, but during the actual scrolling there will be little if any hesitation.

Moving The Train

If you want to have a smoothly moving train, you'll need to use player/missile graphics. You'll get best results with machine language subroutines for movement. The train can still be run with BASIC, however, and the illusion of speed can be maintained if you move the train in increments of, say, half a screen character – two horizontal pixels or four vertical pixels at a time, each way. Movement is a little jerky, but it *is* fast.

Animation will be a little tricky. On straight tracks it is simple enough – you need only four positions for each car – two, if the front and back of the car are identical, so that it doesn't matter which way it is facing. If your engine and train cars are identical, except for color, it is all the simpler, since one shape will control each position for all the cars.

There is nothing wrong with using only straight vertical and horizontal movements – the curving tracks are abrupt enough so that the train won't "leave" the track. However, for smooth movement you may want intermediate positions:

Another animation technique is to use part of your character set to generate trains, with characters representing track sections with train cars on them. By POKEing "train car" characters into screen memory and then restoring the old values afterward, you can get longer, four-colored trains – but with jerkier movement.

You will also need to decide how to handle collisions. Stop one train? Let them pass through each other? Design an explosion?

The answers to these and many other questions are best left to your own creativity. After all, there are hundreds of ways to design elegant programs to bring this game to life. Solving the problems to create *your* version of Railroader is half your fun.

The other half is making layout after layout. No two games will ever be the same; and as generations of model railroaders can tell you, actually

running the trains is just an extra, like the orchestra doing a quick encore when the concert is over.

Variations

After you've carried out this game design (no doubt improving on it many times along the way), you might try one of these variations:

- *Traffic*. One player designs a system of one-way and two-way streets, setting up stoplights. Then up to five players use paddles to drive cars on the streets, getting "tickets" for disobeying laws and losing even more points for crashing, while the program systematically changes the red and green traffic lights.
- *Treasure Map*. Using a font of old-fashioned map characters, a player designs a treasure map; when the game is played, the program randomly or systematically assigns certain treasures and dangers to certain locations.
- *Houseplan*. The player uses the joystick to build the walls of a house, and the keyboard to put in doors and windows and furnish the house.

Does It Matter?

After all, it's only a game. It's only play. It's only supposed to make money, isn't it? Like the movies. The success of a game is measured in dollars per week. It couldn't possibly be art.

But it *is* art. Computer games are created by human beings, using the computer, the television screen, and the sound speaker as their medium. And like other artists, computer gamemakers – let's call them *videowrights* – find that their medium is at once limiting and liberating.

The videowright has only a tiny fraction of the painter's palette to work with. The scan lines and color clocks of the TV set force the videowright to paint in discrete dots, while memory limitations discourage extravagant use of color and images. Yet painters cannot make their paintings move.

Novelists and playwrights can create far deeper characters, far more intricate plots than the videowright, but novelists cannot make you see, and playwrights cannot bring off the fantastic milieux of the videogame.

Above all, the videowright can create an art that the audience takes part in. When you play a videogame, you become part of the act. It's as if you went to the movies and, without stopping the flow of the film, you got to decide what Clint Eastwood or Katharine Hepburn would say next; as if you went to the theatre, and were given a script and put into the play; as if you went to a concert and got to control the program as it went along.

World-Making

Despite their differences, all the arts have some things in common. I believe that this is the most important:

The audience voluntarily comes to dwell in the world that the artist has created.

Playing *Joust* and *Dig-Dug* is more than racking up points. It's dwelling for a time in a world that you can't visit any other way. There are dangers; there are laws; there are strategies for survival; there are rewards for achievement. There is a beginning, an ending. You have more than one chance to make good.

Audience Or Artist

My children are still so young that they don't know that it takes years of training to dance or sing or act out plays or write books. Geoffrey is halfway through writing a novel. Emily improvises plays all day. When the kids like the music they hear, they dance. When they want to sing, they sing, and never mind the melody. And we have enough drawings and paintings to paper a good-sized office building.

We wouldn't dream of telling children that baseball and basketball were only for grownups – they can only go to the ballpark and watch. It's no better to limit them to being in the audience of videogames. Even though it's the most participatory of the arts, the barrier between maker and audience shouldn't be so vast.

Of course, people don't always want to be creative. More often than not, I prefer to play. I like dwelling in some of those worlds that videowrights have made for me.

But when I want a more creative kind of entertainment, I'd like to be able to sit down at the computer and build, the way my children and I build with wooden blocks and plastic bricks. I can always write my own program if I want to, of course. But that's like cutting down a tree and sawing it into blocks and sanding them in order to play with building blocks. Doing it once is fine, but you wouldn't want to have to do it *every* time. ©

DRAGON

De Potter

Steven R McCloskey

Here's a short but exciting game for the VIC-20. Joystick required. Version for the Atari included.

You are a hungry fire-breathing dragon trying to catch some lunch. You're also fighting time as you chase assorted foods up and down ladders and across corridors.

Using a joystick to control the pursuit of your wily prey, you must breathe the fire to consume the apples, pretzels, and other delights by pressing your fire button. But be careful. The feast moves around randomly to avoid the stream of fire.

You are allotted 60 seconds, and if you eat something your score is the amount of time left. If you do this within 60 seconds, you start over but only with 55 seconds and so on down to 10 seconds. If you make a catch within the final 10 seconds, you're back to 60 again. As a warning, the border will change colors when only 5 seconds remain.

If you fail to make your catch in the allotted time, the game ends with an option to play again. Also, "Dragon" records the high score.

Program 1: Dragon – VIC Version

```
20 POKE36879,233:PRINT"{CLR}{11 DOWN}
   {8 RIGHT}DRAGON!"
30 POKE52,28:POKE56,28:CLR
40 FORI=7168TO7679:POKEI,PEEK(I+25600):N
   EXT
50 POKE36869,255
60 FORC=7432TO7551:READA:POKEC,A:NEXT
65 DATA8,42,28,127,28,42,8,0,8,127,93,28
   ,127,73,28,28
70 DATA187,0,238,0,187,0,238,0,127,65,12
   7,65,127,65,127,65
80 DATA85,255,85,0,0,0,0,0,170,255,170,0
   ,0,0,0,0,28,8,28,8,28,8,28,8,8,28,8,2
   8,8,28,8
90 DATA28,3,3,18,58,126,252,72,108,192,1
   92,72,92,126,63,18,54,28,28,73,127,28
   ,93,127,8
95 DATA0,56,124,230,198,206,124,56,68,17
   0,170,146,170,68,186,0,32,16,108,254,
   254,254,124,40
97 DATA255,255,255,255,255,255,255,255
99 PRINT"{CLR}":POKE36879,233:X=7701:FOR
   T=1TO23:POKEX,47:POKEX+30720,1:X=X+22
   :NEXT
100 X=7724:FORT=1TO21:POKEX,35:POKEX+307
    20,2:X=X+1:NEXT
105 X=7766:FORT=1TO19:POKEX,35:POKEX+307
    20,2:X=X+22:NEXT
110 X=7746:FORT=1TO19:POKEX,35:POKEX+307
    20,2:X=X+22:NEXT
115 X=8164:FORT=1TO21:POKEX,35:POKEX+307
    20,2:X=X+1:NEXT
120 X=7768:FORY=1TO6
125 FORA=1TO2:FORT=1TO21:POKEX,35:POKEX+
    30720,2:X=X+1:NEXTT:X=X+1:NEXTA
130 X=X+22:NEXTY
135 X=7747:FORY=1TO7
140 FORT=1TO19:POKEX,36:POKEX+30720,1:X=
    X+22:NEXTT
145 X=X+(-415):NEXTY
170 V=0
180 W=0:H=60:POKE7701,47:POKE7723,47:POK
    E7701+30720,1:POKE7723+30720,1
185 POKEQ+2,0
190 TI$="000000":D=8152:Z=43:Y=-22:P=0:T
    =190:N=130:E=30720:L=-22:O=0:K=39:R=
    36
195 S=7756:J=37151:POKEJ+3,255:POKEJ+3,1
    27:G=0:P=0:POKE36879,233:Q=36874:N=1
    5:POKEQ+4,N
200 A=INT(RND(1)*4)+1:B=INT(RND(1)*3)+1:
    B=B*3
215 IFA=1THENM=+22:C=44:G=36
220 IFA=2THENM=-22:C=44:G=36
225 IFA=3THENM=-1:C=46:G=32
230 IFA=4THENM=+1:C=45:G=32
235 IFPEEK(S+M)=35THEN200
245 POKES,G:POKES+E,1:S=S+M:POKES,C:POKE
    S+E,4
250 IFY=0THEN300
255 POKEQ,T+(Y-2)
300 X=PEEK(J+1)AND128:JE=-(X=.):X=PEEK(J
    ):JS=-((XAND8)=.)
305 JW=-((XAND16)=.):JN=-((XAND4)=.):FB=
    -((XAND32)=.)
307 POKEQ,0:POKEQ+3,0
309 IFFBTHENI=D+L:GOTO800
```

GWENDOLYN.

THERE ARE SOME THINGS YOU KEEP SEARCHING FOR, BEYOND REASON.

Kidnapped in revenge and locked in hatred somewhere deep beneath your castle, is your princess.

Gwendolyn.

The prosperity of your kingdom, the end of a bitter feud, your very future depend on finding her.

You swear that no obstacle can stop you. But the high-resolution, 3-D graphics, animation and sound effects make the obstacles that await you more formidable than you can imagine.

And with over ninety different screens and two full sides of play, those obstacles and the decisions you must make can appear endless. In fact, you may have to endure hours of searching to rescue Gwendolyn.

But for her, you would endure anything, wouldn't you?

These are just three of over ninety exciting screens.

Gwendolyn—a non-violent, intermediate graphic adventure game, written by Marc Russell Benioff, Atari 40K Disk $27.95, Artworx Software Co., Inc., 150 N. Main St., Fairport, N.Y. 14450. For a free catalog of Artworx Software for the Atari, Apple, VIC-20 & Commodore 64 computers, write or call 800-828-6573.

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So you can play.

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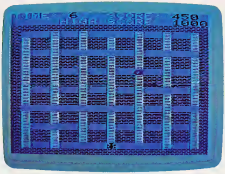

In the VIC version of "Dragon," the hungry monster climbs up and down ladders and across shelves in search of food.

```
310 IFJNTHENY=-22:L=-22:K=39:Z=43:R=36:G
    OTO330
315 IFJETHENY=1:Z=41:L=1:R=32:K=37:GOTO3
    30
320 IFJSTHENY=22:L=22:K=40:R=36:Z=34:GOT
    O330
325 IFJWTHENY=-1:L=-1:K=38:R=32:Z=42:GOT
    O330
327 Y=0
330 IFPEEK(D+Y)=35THENY=0
335 IFY=1ORY=-1THENF=32:GOTO345
340 F=36
345 POKED,F:POKED+E,1:D=D+Y:POKED,Z:POKE
    D+E,0:IFY=0THEN350
347 POKEQ,T+Y
350 PRINT"{HOME}{WHT}TIME:{BLK}";H-INT(T
    I/60);"{LEFT}  ":PRINT"{HOME}
    {10 RIGHT}{WHT}SCORE:{BLK}";W
352 PRINT"{HOME}{DOWN}{5 RIGHT}{WHT}HIGH
     SCORE:{BLK}";V
355 IFTI/60>=HTHEN400
360 IFTI/60>=H-5THENPOKE36879,238
365 B=B-1:IFB=0THEN200
370 GOTO215
400 POKEQ+4,0:POKED,F:POKED+E,1:POKES,G:
    POKES+E,1:IFW>VTHENV=W
410 PRINT"{HOME}{BLK}{6 SPACES}GAME
    {2 SPACES}OVER{28 SPACES}":FORT=1TO1
    000:NEXT
420 PRINT"{HOME}{WHT}PRESS ANY KEY TO PL
    AY HIGH SCORE:{BLK}";V
430 GETA$:IFA$=""THEN430
440 PRINT"{HOME}{44 SPACES}":GOTO180
800 IFPEEK(I)=35THEN810
802 POKEI,K:POKEI+E,7:POKEQ+2,T+(O*5):O=
    O+1:IFO=10THEN814
804 I=I+L
806 IFI=STHEN900
808 GOTO800
810 IFPEEK(I)=35ANDO=0THEN310
812 I=I-L
814 POKEQ+2,T+(O*5)
815 POKEI,R:POKEI+E,1:I=I-L:O=O-1:IFO=0A
    NDU=1THENPOKED,R:POKED+E,1:U=0:GOTO1
    85
816 IFO=0THENPOKEQ+2,0:GOTO310
818 GOTO814
900 POKEI,33:POKEI+E,7:FORM=180TO235STEP
    2:POKEQ+2,M:NEXT
901 POKEQ+4,N:FORM=180TO235STEP2:POKEQ+2
    ,M:FORN=1TO10:NEXTN:NEXTM:POKEQ+2,0
902 POKEQ+4,0:W=W+(H-INT(TI/60)):H=H-5:I
    FH=5THENH=60
904 U=1:O=O+1:GOTO 814
```

Program 2: Dragon – Atari Version

```
10 GRAPHICS 17:SETCOLOR 1,0,12:SETCO
   LOR 0,3,4
20 SETCOLOR 4,9,8:SETCOLOR 2,7,4:POS
   ITION 7,10:PRINT #6;"DRAGON"
30 FOR I=15 TO 0 STEP -0.2:POKE 712,
   104+48*F:F=1-F:FOR W=I*4 TO I*2 S
   TEP -1:SOUND 0,W,10,I:NEXT W:NEXT
    I
40 CHSET=(PEEK(106)-8)*256:IF PEEK(C
   HSET+8)=8 THEN POKE 756,CHSET/256
   :GOTO 99
45 FOR I=128 TO 471:POKE CHSET+I,PEE
   K(57344+I):NEXT I
50 POKE 756,CHSET/256
60 FOR C=0 TO 127:READ A:POKE CHSET+
   C,A:NEXT C
61 DATA 0,0,0,0,0,0,0,0
65 DATA 8,42,28,127,28,42,8,0,8,127,
   93,28,127,73,28,28
70 DATA 187,0,238,0,187,0,238,0,127,
   65,127,65,127,65,127,65
80 DATA 85,255,85,0,0,0,0,0,170,255,
   170,0,0,0,0,0,28,8,28,8,28,8,28,8
   ,8,28,8,28,8,28,8
90 DATA 28,3,3,18,58,126,252,72,108,
   192,192,72,92,126,63,18,54,28,28,
   73,127,28,93,127,8
95 DATA 0,56,124,230,198,206,124,56,
   68,170,170,146,170,68,186,0,32,16
   ,108,254,254,254,124,40
97 DATA 255,255,255,255,255,255,255,
   255
99 PUT #6,125:SCR=PEEK(88)+256*PEEK(
   89):FOR I=2 TO 22:POKE SCR+19+I*2
   0,143:NEXT I
100 FOR T=0 TO 18:POKE SCR+40+T,3:NE
    XT T
105 FOR T=0 TO 18:POKE SCR+60+T*20,3
    :NEXT T
110 FOR T=0 TO 18:POKE SCR+78+T*20,3
    :NEXT T
115 FOR T=0 TO 18:POKE SCR+440+T,3:N
    EXT T
120 X=SCR+80:FOR Y=1 TO 6
125 FOR A=1 TO 2:FOR T=1 TO 19:POKE
    X,3:X=X+1:NEXT T:X=X+1:NEXT A
130 X=X+20:NEXT Y
135 FOR X=0 TO 4:FOR Y=0 TO 18:POKE
    SCR+60+Y*20+X*4+1,68:NEXT Y:NEXT
     X
170 V=0
180 W=0:H=60:REM POKE SCR+21,15:POKE
     SCR+41,15
185 REM
190 POKE 20,0:POKE 19,0:D=SCR+430:Z=
    138:Y=-99:P=0:T=190:E=-1:L=-20:O
    =0:K=7:R=4:POKE 712,9*16+8
195 S=SCR+70:G=0:P=0:N=15
200 A=INT(RND(1)*4)+1:B=INT(RND(1)*3
    )+1:B=B*3
215 IF A=1 THEN M=+20:C=12:G=68
220 IF A=2 THEN M=-20:C=12:G=68
225 IF A=3 THEN M=-1:C=14:G=0
230 IF A=4 THEN M=+1:C=13:G=0
```

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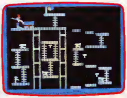

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```
235 IF PEEK(S+M)=3 THEN 2ØØ
245 POKE S,G:S=S+M:POKE S,C
25Ø IF Y=Ø THEN 3ØØ
255 SOUND Ø,T+Y,2,8
3ØØ ST=STICK(Ø)
3Ø7 SOUND Ø,Ø,Ø,Ø
3Ø9 IF STRIG(Ø)=Ø THEN I=D+L:GOTO 8Ø
    Ø
31Ø IF ST=14 THEN Y=-2Ø:L=Y:K=135:Z=
    139:R=68:GOTO 33Ø
315 IF ST=7 THEN Y=1:Z=137:L=1:R=Ø:K
    =133:GOTO 33Ø
32Ø IF ST=13 THEN Y=2Ø:L=Y:K=136:R=6
    8:Z=13Ø:GOTO 33Ø
325 IF ST=11 THEN Y=-1:L=-1:K=134:R=
    Ø:Z=138:GOTO 33Ø
327 Y=(Y=-99)
33Ø IF PEEK(D+Y)=3 THEN Y=Ø
335 IF Y=1 OR Y=-1 THEN F=Ø:GOTO 341
34Ø F=68
341 IF Y=Ø THEN 347
345 POKE D,F:D=D+Y:POKE D,Z:IF Y=Ø T
    HEN 35Ø
347 SOUND Ø,T+Y,12,8
35Ø POSITION 1,Ø:? #6;"time ";H-INT(
    (PEEK(2Ø)+256*PEEK(19))/6Ø);" ";
    :POSITION 1Ø,Ø:? #6;"score ";W
355 TI=PEEK(2Ø)+256*PEEK(19):IF TI/6
    Ø>=H THEN 4ØØ
36Ø IF TI/6Ø>=H-5 THEN SETCOLOR 4,3,
    8
365 8=8-1:IF B=Ø THEN 2ØØ
37Ø GOTO 215
4ØØ SOUND Ø,Ø,Ø,Ø:POKE D,Ø+F*(ABS(Y)
    =2Ø):POKE S,6:IF W>V THEN V=W
41Ø COLOR 32:PLOT Ø,Ø:DRAWTO 19,Ø:PL
    OT Ø,1:DRAWTO 19,1:POSITION Ø,Ø:
    ? #6;" GAME OVEr "
42Ø POSITION 1,1:? #6;"press start t
    o play":POSITION Ø,23:? #6;"HIGH
     score ";V
43Ø IF PEEK(53279)=7 THEN 43Ø
44Ø COLOR 32:PLOT Ø,Ø:DRAWTO 19,Ø:PL
    OT Ø,1:DRAWTO 19,1:GOTO 18Ø
5ØØ INPUT A:A=A-768Ø:Y=INT(A/22):X=A
    -Y*22:? Y*2Ø+X:GOTO 5ØØ
8ØØ IF PEEK(I)=3 THEN 81Ø
8Ø2 POKE I,K:POKE 71Ø,PEEK(5377Ø):SO
    UND Ø,O*5,Ø,8:O=O+1:IF O=1Ø THEN
     814
8Ø4 I=I+L
8Ø6 IF I=S THEN 9ØØ
8Ø8 GOTO 8ØØ
81Ø IF PEEK(I)=3 AND O=Ø THEN 31Ø
812 I=I-L
814 POKE 71Ø,O*5
815 POKE I,R:I=I-L:O=O-1:IF O=Ø AND
    U=1 THEN POKE D,R:U=Ø:POKE 71Ø,1
    16:GOTO 185
816 POKE 71Ø,116:IF O=Ø THEN SOUND Ø
    ,Ø,Ø,Ø:GOTO 31Ø
818 GOTO 814
9ØØ POKE I,129:Y=-99:FOR M=Ø TO 1ØØ
    STEP 1Ø:SOUND Ø,M,12,8:POKE 71Ø,
    PEEK(5377Ø):NEXT M
9Ø1 FOR M=14Ø TO Ø STEP -2:SOUND Ø,M
    ,Ø,M/1Ø:POKE 71Ø,PEEK(5377Ø):NEX
    T M:SOUND Ø,Ø,Ø,Ø:POKE 71Ø,116
9Ø2 W=W+(H-INT((PEEK(2Ø)+256*PEEK(19
    ))/6Ø)):H=H-5:IF H=5 THEN H=6Ø
9Ø4 U=1:O=O+1:GOTO 814
999 GOTO 999
```

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First Math

Steve Hamilton

This math game for children features graphics, color, and sound. In addition to displaying the correct answer after a child has entered an incorrect one, there's a small fanfare for ten consecutive correct answers. Versions for VIC, 64, TI, Radio Shack Color Computer, and Apple.

I was introduced to home computing last May when I bought the VIC-20. I got one partly for my two boys, so they would grow up with some knowledge about a computer. Since the older boy was just approaching kindergarten, I thought it would be at least a year or so before he would be ready to operate the VIC. He was ready long before I had anticipated.

The following is a simple math exercise that I developed for him. In this program, the user is given a choice of exercises: addition, subtraction, multiplication or division. Then, a choice of upper and lower limits is specified for each of the two numbers in each question. Since the computer will generate random numbers, the parameters you choose will become the limits for each number pair. This is how you can adjust the difficulty level.

BEFORE TYPING...
If you're new to computing, please read "How To Type COMPUTE!'s Programs" and "A Beginner's Guide To Typing In Programs."

Program 1: First Math – VIC Version

```
10 POKE36879,111:PRINT"{CLR}{RVS}
   {9 DOWN}{CYN}{6 RIGHT}FIRST MATH":FOR
   I=1TO2000:NEXTI:D=0
30 PRINT"{CLR}{4 DOWN}TO ADD :TYPE +"
50 PRINT"{DOWN}TO SUBTRACT :TYPE -"
70 PRINT"{DOWN}TO MULTIPLY :TYPE *":PRIN
   T"{DOWN}TO DIVIDE :TYPE /":PRINT"
   {3 DOWN}YOUR CHOICE=?{2 SPACES}";
83 GETA$:IFA$<>CHR$(42)ANDA$<>CHR$(43)AN
   DA$<>CHR$(45)ANDA$<>CHR$(47) OR A$=""
   THEN83
84 PRINT"{LEFT}"A$:INPUT"{DOWN}HIGHEST N
   UMBER";UL:INPUT"{DOWN}LOWEST NUMBER";
   R1
90 R=UL+1-R1
95 C=INT(RND(1)*R)+R1:B=INT(RND(1)*R)+R1
100 IFA$=CHR$(43)THENDEF FNA(X)=B+C
110 IFA$=CHR$(45)THEN DEF FNA(X)=B-C
120 IFA$=CHR$(42)THEN DEF FNA(X)=B*C
125 IFA$=CHR$(47)ANDC=0 THEN 95
130 IFA$=CHR$(47)ANDINT(B/C)<>B/C THEN95
135 IFA$=CHR$(47) THEN DEFFNA(X)=B/C
140 PRINT"{CLR}{2 SPACES}NO. OF ANSWERS"
150 PRINT"CORRECT IN A ROW="D:IF D=10 TH
    EN 295
180 E=FNA(X):PRINT:PRINT B;A$;C;"=";:INP
    UTF:IFF<>ETHEN 250
210 PRINT"{7 RIGHT}{3 DOWN}CORRECT"
211 POKE7931,46:POKE7932,46:POKE7975,74:
    POKE7976,75
212 POKE38651,7:POKE38652,7:POKE38695,7:
    POKE38696,7
219 FORT=1TO1000:NEXTT:D=D+1:IFD=10 THEN
     PRINT"{BLK}":GOTO 140
240 GOTO95
250 PRINT"{DOWN} THAT IS NOT CORRECT"
260 PRINTB;A$;C;"=";E
261 POKE7931,46:POKE7932,46:POKE7975,85:
    POKE7976,73
262 POKE38651,7:POKE38652,7:POKE38695,7:
    POKE38696,7
270 FORT=1TO3500:NEXT:D=0:GOTO 140
295 POKE7931,46:POKE7932,46:POKE7975,74:
    POKE7976,75
296 POKE38651,1:POKE38652,1:POKE38695,1:
    POKE38696,1
299 POKE36878,15:FORT=255TO128STEP-1
301 POKE36879,T:POKE36876,T
304 FORT1=1TO5:NEXTT1:NEXTT:FORT=128TO25
    5
309 POKE36879,T:POKE36876,T
312 FORT1=1TO5:NEXTT1:NEXTT
323 POKE36878,0:POKE36879,27
325 PRINT"{4 DOWN}{RIGHT}PLAY AGAIN (
    {RVS}Y{OFF}/{RVS}N{OFF}) ? ";
327 GET A$:IF A$="" THEN 327
328 IF A$="Y" THEN 10
330 PRINT"{CLR}{BLU}":END
```

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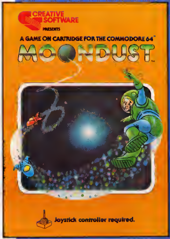

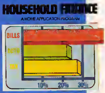

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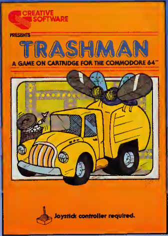

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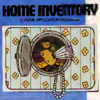

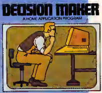

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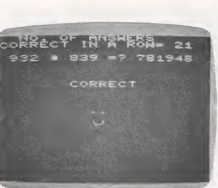
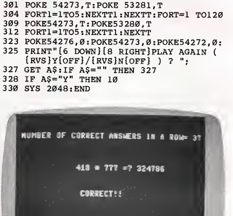


You get a happy face for a correct response in "First Math" – VIC version.

Program 2: First Math – 64 Version

```
5 GOTO 1Ø
6 POKE 172Ø,81:POKE1722,81:POKE1799,74:P
  OKE18ØØ,67:POKE18Ø1,67
7 POKE 18Ø2,67:POKE 18Ø3,75
8 POKE55992,4:POKE55994,4:POKE56Ø71,7:PO
  KE56Ø72,7:POKE 56Ø73,7:POKE 56Ø74,7
9 POKE 56Ø75,7:RETURN
1Ø POKE5328Ø,7:POKE53281,6:PRINT"{CLR}
   {RVS}{9 DOWN}{CYN}{1Ø RIGHT}F I R S T
   {3 SPACES}M A T H":D=Ø
2Ø FOR I=1 TO 2ØØØ:NEXT I
3Ø PRINT"{CLR}{4 DOWN}{3 RIGHT}IF YOU WA
   NT TO ADD, TYPE +"
5Ø PRINT"{DOWN}{3 RIGHT}IF YOU WANT TO S
   UBTRACT, TYPE -"
7Ø PRINT"{DOWN}{3 RIGHT}IF YOU WANT TO M
   ULTIPLY, TYPE *"
72 PRINT"{DOWN}{3 RIGHT}IF YOU WANT TO D
   IVIDE, TYPE /"
75 PRINT"{3 DOWN}{3 RIGHT}YOUR CHOICE=?
   {2 SPACES}";
83 GETA$:IFA$=""THEN83
84 IF A$<>CHR$(42)ANDA$<>CHR$(43)ANDA$<>
   CHR$(45)ANDA$<>CHR$(47)THEN83
85 PRINT"{LEFT}"A$:INPUT"{2 DOWN}
   {3 RIGHT}HIGHEST NUMBER";UL:INPUT"
   {DOWN}{3 RIGHT}LOWEST NUMBER";R1
9Ø R=UL+1-R1
95 C=INT(RND(1)*R)+R1:B=INT(RND(1)*R)+R1
1ØØ IFA$=CHR$(43)THENDEF FNA(X)=B+C
11Ø IFA$=CHR$(45)THEN DEF FNA(X)=B-C
12Ø IFA$=CHR$(42)THEN DEF FNA(X)=B*C
125 IF A$=CHR$(47) AND C=Ø THEN 95
13Ø IF A$=CHR$(47) AND INT(B/C)<>B/C THE
    N 95
135 IF A$=CHR$(47) THEN DEF FNA(X)=B/C
14Ø PRINT"{CLR}{3 DOWN} NUMBER OF CORREC
    T ANSWERS IN A ROW="D:IF D=1Ø THEN 2
    95
18Ø E=FNA(X):PRINT:PRINT"{3 DOWN}
    {11 RIGHT}";B;A$;C;"=";:INPUTF:IFF<>
    ETHEN 25Ø
21Ø PRINT"{13 RIGHT}{3 DOWN}CORRECT!!"
211 GOSUB 6
219 FORT=1TO1ØØØ:NEXTT:D=D+1:IFD=1Ø THEN
     PRINT"{BLK}":GOTO 14Ø
24Ø GOTO95
25Ø PRINT"{DOWN}{5 RIGHT}...THAT IS NOT
    CORRECT"
26Ø PRINT"{11 RIGHT}{DOWN}";B;A$;C;"=";E
261 POKE172Ø,81:POKE1722,81:POKE1799,85:
    POKE 18ØØ,67:POKE18Ø1,67
263 POKE 18Ø2,67:POKE 18Ø3,73
265 POKE55992,4:POKE55994,4:POKE56Ø71,7:
    POKE56Ø72,7:POKE 56Ø73,7:POKE 56Ø74,
    7
267 POKE 56Ø75,7
27Ø FORT=1TO35ØØ:NEXT:D=Ø:GOTO 14Ø
295 GOSUB 6:POKE 54276,17:POKE 54277,3Ø:
    POKE 54278,2ØØ:POKE 54296,15
299 POKE 54272,22Ø:FORT=12Ø TO 1 STEP-1
3Ø1 POKE 54273,T:POKE 53281,T
3Ø4 FORT1=1TO5:NEXTT1:NEXTT:FORT=1 TO12Ø
3Ø9 POKE54273,T:POKE5328Ø,T
312 FORT1=1TO5:NEXTT1:NEXTT
323 POKE54276,Ø:POKE54273,Ø:POKE54272,Ø:
325 PRINT"{6 DOWN}{8 RIGHT}PLAY AGAIN (
    {RVS}Y{OFF}/{RVS}N{OFF} ) ? ";
327 GET A$:IF A$="" THEN 327
328 IF A$="Y" THEN 1Ø
33Ø SYS 2Ø48:END
```



64 version.

Program 3: First Math – TI-99/4A Version

```
1ØØ GOTO 33Ø
11Ø REM MISTAKE IN INPUT
12Ø CALL HCHAR(6,18,32,1Ø)
13Ø GOTO 95Ø
14Ø FOR I=1 TO LEN(H$)
15Ø V=ASC(SEG$(H$,I,1))
16Ø CALL HCHAR(ROW,COL+I,V)
17Ø NEXT I
18Ø RETURN
19Ø ROW=14
2ØØ COL=4
21Ø H$=CHR$(128)&CHR$(129)&CHR$(13Ø
    )&CHR$(142)
22Ø GOSUB 14Ø
23Ø ROW=15
24Ø H$=CHR$(131)&CHR$(132)&CHR$(133
    )&CHR$(141)&CHR$(143)
25Ø GOSUB 14Ø
```

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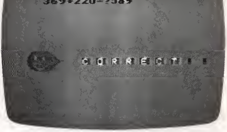
```
260 ROW=16
270 IF CORRECT=0 THEN 300
280 H$=CHR$(134)&CHR$(135)&CHR$(136
    )&CHR$(140)
290 GOTO 310
300 H$=CHR$(137)&CHR$(138)&CHR$(139
    )&CHR$(140)
310 GOSUB 140
320 RETURN
330 RANDOMIZE
340 GOSUB 1560
350 CALL CLEAR
360 FOR J=5 TO 8
370 CALL COLOR(J,16,5)
380 NEXT J
390 CALL SCREEN(4)
400 PRINT TAB(4);"F I R S T
    {4 SPACES}M A T H": : : : : :
    : : : :
410 CALL SOUND(500,262,2,330,2,392,
    2)
420 CALL SOUND(500,262,2,349,2,440,
    2)
430 CALL SOUND(500,262,2,330,2,392,
    2)
440 CALL SOUND(500,247,2,349,2,392,
    2)
450 CALL SOUND(800,262,2,330,2,392,
    2)
460 FOR I=1 TO 300
470 NEXT I
480 CALL CLEAR
490 D=0
500 CALL SCREEN(12)
510 PRINT "TO ADD{12 SPACES}:TYPE +"
    : :
520 PRINT "TO SUBTRACT{7 SPACES}:TY
    PE -": :
530 PRINT "TO MULTIPLY{7 SPACES}:TY
    PE x": :
540 PRINT "TO DIVIDE{9 SPACES}:TYPE
    /": : :TAB(6);"YOUR CHOICE ? "
    ;
550 CALL KEY(0,A,ST)
560 IF (A<>43)*(A<>88)*(A<>45)*(A<>
    47)THEN 550
570 IF A<>88 THEN 590
580 A=120
590 PRINT CHR$(A): : : : : : :
600 INPUT "HIGHEST NUMBER ? ":UL
610 PRINT
620 PRINT
630 INPUT "LOWEST NUMBER ? ":LL
640 R=UL+1-LL
650 C=INT(RND*R)+LL
660 B=INT(RND*R)+LL
670 IF (A=120)+(A=45)+(A=47)THEN 70
    0
680 F=B+C
690 GOTO 790
700 IF (A=120)+(A=47)THEN 730
710 F=B-C
720 GOTO 790
730 IF A=120 THEN 780
740 IF C=0 THEN 650
750 IF INT(B/C)<>B/C THEN 650
760 F=B/C
770 GOTO 790
780 F=B*C
790 CALL CLEAR
```



TI happy face for correct response.

```
800 CALL SCREEN(10)
810 ROW=3
820 COL=2
830 H$="CORRECT ANSWERS IN A ROW ="
840 GOSUB 140
850 COL=29
860 H$=STR$(D)
870 GOSUB 140
880 FOR I=1 TO 50
890 NEXT I
900 IF D=10 THEN 1390
910 ROW=6
920 COL=6
930 H$=STR$(B)&CHR$(A)&STR$(C)&CHR$
    (61)&CHR$(63)
940 GOSUB 140
950 H$=""
960 C$=""
970 K=0
980 CALL KEY(0,E,ST)
990 IF ST=0 THEN 980
1000 IF E=13 THEN 1090
1010 IF ((E<48)+(E>57))*(E<>45)THEN
     110
1020 H$=CHR$(E)
1030 C$=C$&H$
1040 ROW=6
1050 K=K+1
1060 COL=18+K
1070 GOSUB 140
1080 GOTO 980
1090 E=VAL(C$)
1100 IF E<>F THEN 1230
1110 CORRECT=1
1120 GOSUB 190
1130 COL=11
1140 ROW=15
1150 H$="C O R R E C T ! !"
1160 GOSUB 140
1170 FOR I=1 TO 200
1180 NEXT I
1190 REM SMILE
1200 D=D+1
1210 IF D=10 THEN 790
1220 GOTO 650
1230 REM INCORRECT
1240 CORRECT=0
```

```
1250 GOSUB 190
1260 H$=" SORRY, BUT "
1270 ROW=15
1280 COL=9
1290 GOSUB 140
1300 H$=STR$(B)&CHR$(A)&STR$(C)&" "
     &CHR$(61)&" "&STR$(F)&"."
1310 COL=13
1320 ROW=19
1330 GOSUB 140
1340 REM FROWN
1350 FOR I=1 TO 800
1360 NEXT I
1370 D=0
1380 GOTO 790
1390 REM UP&DOWN SOUND,LIGHT
1400 CALL CLEAR
1410 FOR I=16 TO 1 STEP -1
1420 CALL SOUND(2,I*50+60,6)
1430 CALL SCREEN(I)
1440 NEXT I
1450 FOR I=1 TO 16
1460 CALL SOUND(2,I*50+60,6)
1470 CALL SCREEN(I)
1480 NEXT I
1490 CALL SCREEN(3)
1500 PRINT TAB(3);"Y O U{3 SPACES}D
      I D{3 SPACES}I T ! !": : : :
     : :
1510 PRINT "{4 SPACES}TRY AGAIN (Y/
     N)?";
1520 CALL KEY(0,E,ST)
1530 IF ST=0 THEN 1520
1540 IF E=ASC("Y")THEN 480
1550 END
1560 REM DEFINE CUSTOM CHARACTERS
1570 FOR I=128 TO 143
1580 READ A$
1590 CALL CHAR(I,A$)
1600 NEXT I
1610 DATA 030F1F3F7F7FFFFE,FFFFFFFF
     FFFFFF3E,F0FCFEFFFFFFFF3F
1620 DATA FEFEFEFFFFFFFFFF,3E3E3EFF
     F7EFDFE3,3F3F3FFFFFFFFFFF
1630 DATA FFF97C3E1F0F0701,FFFFFF7F
     0080FFFF,FFCF9F3F7FFFFEF8
1640 DATA FFFF7E3C1D0F0701,FF0000FF
     FFFFFFFF,FF7F3F9FDFFFFEFB
1650 DATA F8F0E0C080000000,FC9E6FEF
     EF1FFEFC,00000080C0E0F0F8
1660 DATA 000080F8C0800000
1670 FOR J=13 TO 14
1680 CALL COLOR(J,14,1)
1690 NEXT J
1700 RETURN
```

Program 4:
First Math – Color Computer Version

```
100 CE=128+16*2+15:CN=128+16*7+15:C
    M=128+16*3+15
110 CLS 7
120 PRINT@231,"F I R S T{3 SPACES}M
     A T H";:FOR I=1 TO 1200:NEXT I
130 CLS 3:PRINT@99,"TO ADD: TYPE +
    ";
140 PRINT@163,"TO SUBTRACT: TYPE -
    ";
150 PRINT@227,"TO MULTIPLY: TYPE *
    ";
160 PRINT@291,"TO DIVIDE: TYPE / ";
170 PRINT@387,"YOUR CHOICE ";:INPUT
     A$:IF A$<>("+") AND A$<>("-")
    AND A$<>("*") AND A$<>("/") THE
    N 170
180 PRINT@387,"HIGHEST NUMBER ";:IN
    PUT UL
190 PRINT@451,"LOWEST NUMBER ";:INP
    UT LL
200 R=UL+1-LL
210 B=INT(RND(R))+LL-1:C=INT(RND(R)
    )+LL-1
220 CLS:PRINT@67,"CORRECT ANSWERS I
    N A ROW=";D:IF D=10 THEN 430
230 IF A$="+" THEN E=B+C:GOTO 290
240 IF A$="-" THEN E=B-C:GOTO 290
250 IF A$="*" OR A$="X" THEN E=B*C:
    A$="X":GOTO 290
260 IF A$="/" AND C=0 THEN 210
270 IF A$="/" AND INT(B/C)<>B/C THE
    N 210
280 IF A$="/" THEN E=B/C
290 PRINT@137,B;A$;C;"=";:INPUT F:I
    F F<>E THEN 360
300 PRINT@200,"C O R R E C T ! !";
310 PRINT@268,CHR$(CE);"{3 SPACES}"
    ;CHR$(CE):PRINT@334,CHR$(CN)
320 PRINT@395,CHR$(CM);"{5 SPACES}"
    ;CHR$(CM)
330 PRINT@428,CHR$(CM);"{3 SPACES}"
    ;CHR$(CM)
340 PRINT@461,CHR$(CM)+CHR$(CM)+CHR
    $(CM)
```

Color Computer version.

```
350 FOR I=1 TO 900:NEXT I:D=D+1:GOT
    O 210
360 SOUND 1,3:PRINT@196,"SORRY, BUT"
370 PRINT@207,B;A$;C;"=";E;"."
380 PRINT@268,CHR$(CE);"{3 SPACES}"
    ;CHR$(CE):PRINT@334,CHR$(CN)
390 PRINT@397,CHR$(CM)+CHR$(CM)+CHR
    $(CM)
400 PRINT@428,CHR$(CM);"{3 SPACES}"
    ;CHR$(CM)
```

```
410 PRINT@459,CHR$(CM);"{5 SPACES}"
    ;CHR$(CM)
420 FOR I= 1 TO 2500:NEXT I:O=Ø:GOT
    O 220
430 REM YOU OIO IT!!
440 FOR I=8 TO Ø STEP -1:SOUNO I*3Ø
    +5,2:CLS I:NEXT I
450 FOR I=Ø TO B:SOUNO I*3Ø+5,1:CLS
     I:NEXT I
460 CLS 7:PRINT@1Ø6,"YOU OIO IT!!";
470 PRINT@167,"PLAY AGAIN (Y/N) ";:
    INPUT A$:IF A$="Y" THEN O=Ø:GOT
    O 130
480 CLS:END
```

Program 5: First Math – Apple Version

```
100  GOSUB 67Ø
110  GOTO 26Ø
120  OIM X(1ØØ),Y(1ØØ)
130 P = 2 * (355 / 113): FOR I = 1 TO 1
     ØØ:ANGLE = P * (I / 1ØØ):X(I) = 15
      *  SIN (ANGLE):Y(I) = 15 *  COS (
     ANGLE): NEXT I
140  RETURN
150  POKE 23Ø,32: CALL 6245Ø: HGR : CALL
      - 1994: GR : COLOR= 7: PLOT 16,15
     : PLOT 24,15: COLOR= 4: PLOT 2Ø,19
160  COLOR= 11: IF C1 = Ø THEN 19Ø
170  PLOT 15,23: PLOT 25,23: PLOT 16,24
     : PLOT 24,24: PLOT 17,25: PLOT 23,
     25: HLIN 1B,22 AT 26
180  GOTO 2ØØ
190  HLIN 1B,22 AT 23: PLOT 17,24: PLOT
     23,24: PLOT 16,25: PLOT 24,25: PLOT
     15,26: PLOT 25,26
200  COLOR= 1
210  FOR I = 1 TO 1ØØ: PLOT X(I) + 2Ø,Y
     (I) + 2Ø: NEXT I
220  VTAB 22: HTAB 1Ø: FLASH : IF C1 =
     1 THEN  PRINT "  G O O O   J O B !
     ! ": NORMAL : GOTO 25Ø
230  NORMAL : VTAB 22: HTAB 6: PRINT "S
      O R R Y , B U T  ";B;" ";A$;" ";C
     ;"=";" ";: INVERSE : PRINT E: NORMAL
240  FOR I = 1 TO 2ØØØ: NEXT I
250  FOR I = 1 TO 15ØØ: NEXT I: HOME : HGR
     : POKE 34,Ø: HOME : TEXT : RETURN
260  HOME : INVERSE : VTAB 1Ø: HTAB 12:
      PRINT "F I R S T   M A T H": NORMAL
     : VTAB 18: HTAB 4: PRINT ". . . W
     A I T  A  S E C O N D"
270  GOSUB 12Ø
280  HOME : VTAB 4: HTAB 7: PRINT "TO "
     ;: INVERSE : PRINT "ADO";: NORMAL
     : PRINT "       : TYPE +"
290  VTAB 6: HTAB 7: PRINT "TO ";: INVERSE
     : PRINT "SUBTRACT";: NORMAL : PRINT
     " : TYPE -"
300  VTAB 8: HTAB 7: PRINT "TO ";: INVERSE
     : PRINT "MULTIPLY";: NORMAL : PRINT
     " : TYPE *"
310  VTAB 1Ø: HTAB 7: PRINT "TO ";: INVERSE
     : PRINT "DIVIDE";: NORMAL : PRINT
     " : TYPE /"
320  VTAB 13: HTAB 7: PRINT "YOUR CHOIC
     E= ";
330  INPUT A$: IF A$ <  > ("*") AND A$ <
      > ("+") AND A$ <  > ("-") AND A$ <
      > ("/") THEN 33Ø
340  VTAB 17: HTAB 7: INPUT "HIGHEST NU
     MBER= ?";UL: VTAB 19: HTAB 7: INPUT
     "LOWEST NUMBER=  ?";LL
350 R = UL + 1 - LL
360 C =  INT ( RNO (1) * R) + LL:B =  INT
     ( RNO (1) * R) + LL
370  IF A$ = ("+") THEN  OEF  FN A(X) =
     B + C
380  IF A$ = ("-") THEN  OEF  FN A(X) =
     B - C
390  IF A$ = ("*") THEN  OEF  FN A(X) =
     B * C
400  IF A$ = ("/") AND C = Ø THEN 36Ø
410  IF A$ = ("/") ANO  INT (B / C) <  >
     B / C THEN 36Ø
420  IF A$ = ("/") THEN  OEF  FN A(X) =
     B / C
430  HOME : VTAB 7: HTAB B: PRINT "CORR
     ECT ANSWERS IN A ROW= ";: INVERSE
     : PRINT D: NORMAL
440 E =  FN A(X): VTAB 15: HTAB 15: PRINT
     B;" ";A$;" ";C;"= ";: INPUT F: IF
     F <  > E THEN 4BØ
450  HOME :C1 = 1: GOSUB 15Ø
460 D = D + 1: IF O = 1Ø THEN 5ØØ
470  GOTO 36Ø
480  HOME :C1 = Ø: GOSUB 15Ø
490 O = Ø: GOTO 43Ø
500  REM  YOU WIN!!
510 D = Ø: GOSUB 56Ø
520  VTAB 22: HTAB 8: FLASH : PRINT "
     Y O U   O I O   I T !!"
530  FOR I = 1 TO 5: POKE 76B,1: POKE 7
     69,2ØØ - I * 3Ø: CALL 77Ø: NEXT I:
      FOR I = 1 TO 1Ø: POKE 76B,1: POKE
     769,4Ø + I * 2Ø: CALL 77Ø: NEXT I
540  NORMAL : VTAB 24: HTAB 1Ø: PRINT "
     TRY AGAIN (Y/N) ?";: GET A$: IF A$
      = ("Y") THEN  TEXT : GOTO 2BØ
550  TEXT : HOME : HTAB 5: VTAB B: PRINT
     "...SEE YA LATER...": ENO
560  POKE 23Ø,32: CALL 6245Ø: HGR : CALL
      - 1994: GR
570  FOR J = 1 TO 3
580 CL = Ø:LØ = Ø:H1 = 19:S1 = 1: GOSUB
     62Ø
590 CL = 17:LØ = 19:H1 = Ø:S1 =  - 1: GOSUB
     62Ø
600  NEXT J
610  RETURN
620  FOR I = LØ TO H1 STEP S1: COLOR=  INT
     ( RND (1) * CL):X1 = 19 - I:X2 = 2
     Ø + I:Y1 = 19 - I:Y2 = 2Ø + I
630  HLIN X1,X2 AT Y1: VLIN Y1 + 1,Y2 AT
     X2
640  HLIN X2 - 1,X1 AT Y2: VLIN Y2 - 1,
     Y1 AT X1
650  NEXT I
660  RETURN
670  REM  LOAD MUSIC ROUTINE
680  FOR I = 77Ø TO 795: READ M: POKE I
     ,M: NEXT I
690  OATA  172,Ø1,Ø3,174,Ø1,Ø3,169,Ø4,3
     2,168,252,173,48,192,232,2Ø8,253,1
     36,2ØB,239,2Ø6,Ø,Ø3,2ØB,231,96
700  RETURN
```

©

BLOCKHEAD

Matt Giwer

The blockhead moves vertically, bouncing as he goes, and tries to pop the floating balloons. You must catch him as he comes down, but his wildly erratic movements make that very difficult. Versions for 64 and Atari – requires paddles.

"Blockhead" is similar to some of the early arcade games. You will need a paddle in position one to play. The knob controls the position, and the trigger bounces the blockhead. The objective is to pop the balloons and catch the blockhead when he comes back down. When the blockhead hits the balloons, there will be an explosion; he will be bounced around, hitting more balloons.

After you clear one screen of balloons, you will get a new set and advance to the next level of play. At each advancing level the blockhead moves more wildly as he comes down. More balloons will be punctured, but there is also a greater chance either of missing him or of his being thrown outside the area of play. There are five blockheads per game. When you miss the last one, you will be given the opportunity for a new game.

Subroutine Strategy

Although Blockhead seems like a simple game, there is more involved than might first be imagined. Let's take a look at the game logistics in the Atari version. The blockhead must move up and down. A calculated trajectory would slow down the game considerably, so the vertical motions are stored in strings, BU$ and BD$. The numbers in these strings, in groups of three, are the vertical positions that use VAL(BU$(x,x + 2)) POKEd into PLY, which is the vertical position of the blockhead. Blockhead is Player 0 of the P/M graphics.

Since activities such as scoring are sometimes required to be called out of the normal game sequence, this is a subroutine-oriented program. For example, when the last blockhead is missed, the game goes to the subroutine at line 6000. The number of balloons broken still has to be counted, so the subroutine SCORE is called here also. At line 1910, the start of the first game, or at line 6030, the start of a new game, the program waits for a trigger pull by calling the subroutine TRGR. But when it goes to a new level, line 5840, there is no need to wait for a trigger pull, so it is not called. Line 2175 sets up a new game, but only after the player has agreed by pulling the trigger as called in line 6030.

The rest of the game is straightforward. The P/M graphics are set up starting at line 30000. From this line on, REMs are used to indicate significant routines, statements, or definitions. The Vertical Blank Interrupt routine defines player movement. The definition of each player is also noted by REMs.

The lines discussed below are of special interest.

Lines 5012 and 5512 evaluate the BU$ and BD$ to determine the vertical positions.

Line 5109 determines the horizontal position of the blockhead with respect to the position of the graphics.

Lines 5110-5114 pop balloons two or four at a time depending on the size of the player. The eight bits of the player control eight color clocks, while the eight bits of a character in GRAPHICS 0 control only half-color clocks. The result is that eight bits in P/M graphics are twice as wide as eight bits in normal graphics.

Line 5810 calls the machine language string written in line 51. This routine reads the top lines of the screen and counts the number of occurrences of the CTRL T "balloons" at the top of the screen. The 23rd character in this string, the uppercase T, determines which character is searched for. To search for a different character, the T must be replaced. First look at Table 9.6 (p. 55) of the *Atari BASIC Reference Manual* and find the number of the character you want to search for. Then look at Appendix C and find the ATASCII character for that number, and substitute the ATASCII character for the T. This machine language string works for only the first 256 locations on the screen, or for about six and one-half lines.

Note the POKE PLX + 1, PADDLE(0) used in most subroutines. This is the catching platform; you are asked to update its position whenever possible. This is required so the platform won't end up off of the screen as you turn the knob.

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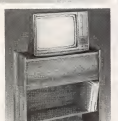

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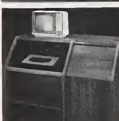

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Notes For 64 Version Of Blockhead

Gregg Peele, Programming Assistant

The Commodore 64 version of "Blockhead" utilizes the eight available sprites and an interrupt-driven routine which continues running even when the BASIC program is stopped. Using this machine language routine provides for optimal motion within the game and provides a means to constantly monitor the position of the sprites and set or unset the most significant bit of each sprite depending on which side of the "seam" the sprite is on.

This game works using a timer. The object of the game is to "pop" the balloons as they float across the sky. The more balloons that you pop within your time limit, the more points you receive. Not only must you continually attempt to pop balloons, but you must also catch the blockhead before he falls below his home base. If you miss catching him, points are deducted until you can bring him back to the surface (using the fire button).

The original version of this game is written to be used with Atari-style paddles. If you have Commodore paddles, you must change lines 1070 and 1080 to read as follows:

```
1070 DATA 216,24,173,164,194,105,28,141
1080 DATA 161,194,56,173,164,194,233,217
```

This alteration leaves a slight glitch in the paddle movement around the seam but provides for optimal range for movement around the screen.

Blockhead utilizes the collision register to detect when one sprite "touches" another sprite. Since the collision register is changed only temporarily when sprites collide, the contents representing the collision must be saved until an event occurs which may again make the sprite collide with another sprite. The stored register is then cleared and the sprite is again ready for collision. Collision detection between the blockhead and the balloons is handled through BASIC. Since BASIC runs at a relatively slow rate, the blockhead must hit the balloon squarely to initiate a collision. A glancing blow will not generally "pop" a balloon.

BEFORE TYPING...
If you're new to computing, please read "How To Type COMPUTE!'s Programs" and "A Beginner's Guide To Typing In Programs."

Program 1: Atari Blockhead

```
50 DIM B$(40)
51 B$="hMY{E}MX{E}UD{,}{E}T{E}U"
   {,}■{,}LVIT P{A}hK{X}T{,}PS{J}{E}T
   ""
90 DIM T1$(35),BU$(60),BD$(60),N$(10
   )
95 BU$="182152127107092072067062057O
   52045"
96 BD$="045052057062067072092107127l
   521B2192212255"
97 N$="1 2 3 4 5 "
100 BOUNCEUP=5000:HITTEST=5100:MOVE2
    =5200:SETUP=5300:START=5400:BOUN
    CEDOWN=5500:CATCH=5600:MISS=5700
110 SCORE=5800:START1=5450:LEVEL=590
    0:LOSS=6000:EXPLO=6100:TRGR=6200
150 LEV=3:C=1:PPP=9
1900 GOSUB 30000
1910 GOSUB START:GOSUB TRGR:GOSUB ST
     ART1
2000 REM CONTROL LOOP
2100 FOR IJK=0 TO 1 STEP 0
2150 GOSUB MOVE2
2160 GOSUB BOUNCEUP
2170 GOSUB BOUNCEDOWN
2175 IF NGAME=1 THEN GOSUB START:GOS
     UB START1:NGAME=0:GOTO 2900
2180 GOSUB SCORE
2900 NEXT IJK
5000 REM BOUNCEUP
5005 I=-1:B=A
5007 C=-C
5010 FOR IJK=0 TO 1 STEP 0:I=I+1:POK
     E 53278,0
5012 TRAP 5090:R=VAL(BU$(I*3+1,I*3+3
     )):TRAP 40000
5020 POKE PLY,R:SOUND 0,R+A,10,15
5022 IF PEEK(53252)<>0 THEN IF B<58
     OR B>190 THEN POKE 53278,0:C=-C
     :B=B+(10*C):POKE PLX,B
5030 POKE PLX,B:IF PEEK(53252)<>0 TH
     EN GOSUB HITTEST:GOTO 5080
5070 A=PADDLE(0):POKE PLX+1,A
5080 NEXT IJK
5090 RETURN
5100 REM HITTEST
5105 POKE PLX+3,0:POKE 53278,0:IF B<
     54 OR B>192 THEN 5190
5109 BB=INT((B-46)/4):POKE PLX+1,PAD
     DLE(0)
5110 IF R=67 THEN POSITION BB,4:? "
     ";:GOTO 5140
5111 IF R=62 THEN POSITION BB,4:? "
     {DOWN}{2 LEFT}   ";:GOTO 5140
5112 IF R=57 THEN POSITION BB,3:? "
     {DOWN}{2 LEFT}   ";:GOTO 5140
5113 IF R=52 THEN POSITION BB,2:? "
     {DOWN}{2 LEFT}   ";:GOTO 5140
5114 IF R=45 THEN POSITION BB,1:? "
     {DOWN}{2 LEFT}   ";
5140 POKE PLX+2,B:POKE PLY+2,R:SOUND
```

```
     1,R+BB,6,15:B=B+4*INT(3*RND(0)
     -1):I=I-INT(2*RND(0)):SOUND 1,0
     ,0,0
5150 POKE PLX+2,0:POKE PLY+2,0
5190 RETURN
5200 REM MOVE2 CLOWN AND PLATFORM
5210 FOR IJK=0 TO 1 STEP 0
5218 A=PADDLE(0)
5230 TRAP 5240:POKE PLX,A:POKE PLX+1
     ,A:TRAP 40000
5240 IF PTRIG(0)=0 THEN 5290
5280 NEXT IJK
5290 POKE PLX+3,A:POKE PLY,172:Q=1*1
     :POKE 77,0:RETURN
5300 REM SETUP
5320 POKE PLX,100:POKE PLY,180
5322 POKE PLX+1,100:POKE PLY+1,192
5324 POKE PLX+3,0:POKE PLY+3,183
5390 RETURN
5400 REM START
5410 T1$="{32 T}"
5420 FOR I=1 TO 4:POSITION 4,I:? T1$
     :NEXT I
5430 FOR I=0 TO 20:POSITION 1,I:? "
     {B}";:NEXT I
5431 FOR I=0 TO 20:POSITION 38,I:? "
     {V}";:NEXT I:POSITION 2,21:? N$
     ;
5432 POSITION 2,22:? "PUSH TRIGGER T
     O START{10 SPACES}";
5439 RETURN
5450 POSITION 2,21:? N$;" LEVEL:";LE
     V;"  SCORE: ";SC;
5454 POSITION 2,22:? "{31 SPACES}";:
     POSITION 10,21:? " ";:Q=1^1
5460 POKE 77,0:N$(9,9)=" "
5470 POSITION 12,22:? "HIGH SCORE ";
     HSCR
5490 RETURN
5500 REM BOUNCEDOWN
5505 I=-1:POKE 53278,0
5510 FOR IJK=0 TO 1 STEP 0:I=I+1:POK
     E 53278,0
5512 TRAP 5585:R=VAL(BD$(I*3+1,I*3+3
     )):TRAP 40000
5520 POKE PLY,R:SOUND 0,R+A,10,15
5521 POSITION 4,22:? I;
5522 IF PEEK(53252)<>0 THEN IF B<58
     OR B>190 THEN POKE 53278,0:C=-C
     :B=B+(10*C):POKE PLX,B
5528 TRAP 5529:B=B+(LEV*C):POKE PLX,
     B:TRAP 40000
5529 IF PEEK(53252)<>0 THEN GOSUB HI
     TTEST:GOTO 5080
5530 IF PEEK(53261)<>0 THEN GOSUB CA
     TCH:SOUND 0,0,0,0:GOTO 5590
5570 POKE PLX+1,PADDLE(0):GOTO 5580
5580 NEXT IJK
5585 GOSUB MISS:SOUND 0,0,0,0
5590 RETURN
5600 REM CATCH
5610 POKE PLY,182:POKE 53278,0
5690 RETURN
5700 REM MISS
5710 SOUND 0,0,0,0:POKE 53278,0:GOSU
     B EXPLO
5720 PPP=PPP-2:IF PPP=-1 THEN GOSUB
     LOSS:GOTO 5790
5722 N$(PPP,PPP)=" "
5724 GOSUB START1
5780 POKE PLY,182
5790 RETURN
5800 REM SCORE
5805 JUMPS=JUMPS+2
5810 S=USR(ADR(B$))
5820 SCR=128-S:SC=SCR*5-JUMPS+SCC
5830 POSITION 29,21:? SC;
5840 IF S=0 THEN GOSUB LEVEL:GOSUB S
     TART:GOSUB START1:POKE 53761,16
     0
5890 RETURN
5900 REM LEVEL
5910 LEV=LEV+3
5920 SCC=SC
5990 RETURN
6000 REM LOSS
6005 GOSUB SCORE
6010 IF SC>HSCR THEN HSCR=SC
6020 POSITION 10,10:? "SORRY, YOU LO
     SE";
6030 POSITION 9,11:? "PUSH TRIG FOR
     ANOTHER GAME";:SCC=0:SOUND 0,0,
     0,0:JUMPS=0:LEV=3:SC=0:PPP=9
6035 GOSUB TRGR
6040 POSITION 2,21:? "{35 SPACES}";
6080 POSITION 10,10:? "{15 SPACES}";
6082 POSITION 9,11:? "{26 SPACES}";:N
     GAME=1:N$="1 2 3 4 5 "
6090 RETURN
6100 REM EXPLO
6105 FOR IKK=14 TO 0 STEP -2
6110 SOUND 3,200/(IKK+1),0,15:Q=1^1
6112 A=PADDLE(0):POKE PLX,A:POKE PLX
     +1,A
6115 NEXT IKK
6120 SOUND 3,0,0,0
6190 RETURN
6200 REM TRGR INPT
6210 IF PTRIG(0)=1 THEN 6210
6290 RETURN
30000 REM *****PM SETUP*****
30010 GRAPHICS 0:POKE 106,PEEK(106)-
      16:GRAPHICS 0:POKE 752,1
30204 POKE 53277,3:REM *****GRACTL P
      LAY&MISS*****
30206 POKE 559,62:REM *****DMACTL,1L
      INE,PLAY,MIS,NORM FIELD*****
30208 POKE 54279,PEEK(106):REM *****
      32PAGE RESERVE*****
30210 POKE 53256,0:POKE 53257,0:POKE
       53258,0:POKE 53259,0:REM ****
      *PLAY SIZES*****
30212 POKE 623,33:REM *****PRIORITY
      PF OVER PL*****
30214 MYPMBASE=256*PEEK(106):REM ***
      **NEW PM BASE*****
30230 POKE 704,150:POKE 705,199:POKE
       706,15:POKE 707,199:POKE 1788
      ,(PEEK(106)+4):REM *****START
      OF PM DATA*****
30232 POKE 710,52:POKE 709,58:POKE 7
      11,29:POKE 712,0
30236 REM *****VBLANK INTERUPT ROUTI
      NE*****
30238 FOR I=1536 TO 1706:READ A:POKE
       I,A:NEXT I
30240 FOR I=1774 TO 1787:POKE I,0:NE
      XT I
30242 DATA 162,3,189,244,6,240,89,56
      ,221,240,6,240,83,141,254,6,10
      6,141
30244 DATA 255,6,142,253,6,24,169,0,
      109,253,6,24,109,252,6,133,204
      ,133
```

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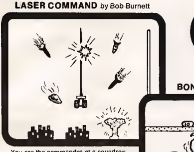
LASER COMMAND by Bob Burnett



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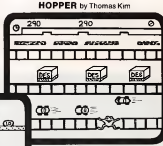
HOPPER by Thomas Kim



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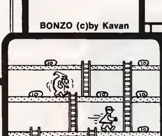

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VIC STAT **$49.95**
Vic Stat is a cartridge which will simplify your work with statistics and graphic displays It will add approximately 15 commands to BASIC. For example, bar chart, horizontal or vertical, plotting with 2024 points, printout of screen Statistical commands tor calculations ot, for example, mean value, standard deviation, variance, etc

VIC REL **$59.95**
The purpose of this cartridge is to simplify control of, for example, burglar alarms, garage doors, door locks, heating elements, lamps, radios, remote controllers, valves, pumps, telephones, accumulators, irrigation systems, electrical tools, stop watches, ventilators, humiditiers, etc , etc This cartridge contains 6 relay outputs and 2 inputs ot type optocoupler For the VIC-20 and Commodore 64

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```
30246 DATA 206,189,240,6,133,203,173
      ,254,6,133,205,189,248,6,170,2
      32,46,255
30248 DATA 6,144,16,168,177,203,145,
      205,169,0,145,203,136,202,208,
      244,76,87
30250 DATA 6,160,0,177,203,145,205,1
      69,0,145,203,200,202,208,244,1
      74,253,6
30252 DATA 173,254,6,157,240,6,189,2
      36,6,240,48,133,203,24,138,141
      ,253,6
30254 DATA 109,235,6,133,204,24,173,
      253,6,109,252,6,133,206,189,24
      0,6,133
```

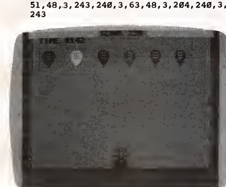
In "Blockhead," the figure bounces to the top of the screen to pop balloons – Atari version.

```
30256 DATA 205,189,248,6,170,160,0,1
      77,203,145,205,200,202,208,248
      ,174,253,6
30258 DATA 169,0,157,236,6,202,48,3,
      76,2,6,76,98,228,0,0,104,169
30260 DATA 7,162,6,160,0,32,92,228,9
      6
30262 S=USR(1696)
30276 PLX=53248:PLY=1780:PLL=1784
30278 POKE PLL,11:POKE PLL+1,8:POKE
      PLL+2,16:POKE PLL+3,9
30282 FOR I=MYPMBASE+1024 TO MYPMBAS
      E+1034:READ A:POKE I,A:NEXT I:
      REM *****BLOCKHEAD PLAYER 0***
      **
30283 DATA 60,60,60,60
30284 DATA 24,126,24,24,126,68,195
30285 FOR I=0 TO 7:POKE MYPMBASE+128
      0+I,255:NEXT I:REM *****PLATFO
      RM PLAYER 1*****
30299 REM *****EXPLOSION PLAYER 2***
      **
30300 FOR I=MYPMBASE+1280+256 TO MYP
      MBASE+256+1295:READ A:POKE I,A
      :NEXT I
30305 DATA 17,196,67,24,157,102,126,
      60,60,126,102,153,24,74,32,146
30309 REM *****SPRING PLAYER 3*****
30310 FOR I=MYPMBASE+1280+512 TO MYP
      MBASE+1288+512:READ A:POKE I,A
      :NEXT I
30315 DATA 255,255,32,16,8,4,8,16,32
30330 GOSUB SETUP
30590 RETURN
```

Program 2: Blockhead For 64

```
90 REM BLOCKHEAD FOR 64
100 POKE49152,Ø
110 DIM HA(12),HB(12),HC(12),LA(12),LB(1
    2),LC(12)
120 FORQ=1TO11:READHA(Q),LA(Q),HB(Q),LB(
    Q),HC(Q),LC(Q):NEXT
130 S=54272:FORE=STOS+28:POKEE,Ø:NEXT
140 POKE54296,15 :POKE54277,56 :POKE5427
    8,212
150 POKE54284,56 :POKE54286,212
160 POKE54291,56 :POKE54292,212
170 POKE S+4,17:POKES+16,17:POKES+18,17
180 FORD=1TO11
190 POKES+1,HA(D):POKES,LA(D):POKES+8,HB
    (D)
200 POKES+9,LB(D):POKES+15,HC(D):POKES+1
    4,LC(D)
210 FORT=1TO1ØØ:NEXT
220 IFHC(D) =7THENFORT=1TO1ØØ:NEXT
230 NEXT
240 FORT=1TO 45Ø :NEXT:FORE=STOS+28:POKE
    E,Ø:NEXT
250 IFPEEK(49152)=173ANDTH=1THENRETURN
260 DATA33,135,21,31,8,97,31,165,21,31,8
    ,225,29,223,22,96,9,1Ø4
270 DATA 28 ,49,22,96,9,247,26,156,21,31
    ,1Ø,143
280 DATA28,49,21,31,9,247,29,223,22,96,9
    ,1Ø4,31,165,22,96,8,225
290 DATA33,135,21,31,8,97,25,3Ø,22,96,7,
    233,33,135,21,31,8,97
300 GOTO33Ø
310 S=54272
320 POKES+24,15:POKE54276,65:POKE54275,1
    Ø:POKE54274,1Ø:POKES+24,Ø:RETURN
330 POKE53281,7:HI=134:GOSUB93Ø
340 DATA1,255,Ø,7,255,192,15,239,224,31,
    1,24Ø,63,1Ø9,248,63,111,248,63,1,248
    ,63
350 DATA237,248,63,1Ø9,248,31,1,24Ø,31,2
    39,24Ø,15,239,224,15,255,224,7,255,1
    92,3
360 DATA255,128,1,255,Ø,Ø,254,Ø,Ø,124,Ø,
    Ø,56,Ø,Ø,16,Ø,Ø,56,Ø
370 V=53248
380 FOR J=96ØTO1Ø22:READ WQ:POKE J,WQ:NE
    XT
390 POKEV+21,Ø
400 POKEV+41,6:POKEV+42,Ø:POKEV+43,1:POK
    EV+44,2:POKEV+4,7Ø
410 POKE53264,Ø
420 POKEV+45,4:POKEV+46,8
430 FORT=2Ø42TO2Ø47:POKET,15:NEXT:POKEV+
    21,255
440 IFPEEK(V+2)<5ØAND(PEEK(V+16)AND2)=ØT
    HENPOKEV+2,254
450 DATAØ,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,
    Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,Ø,255,255,255,25
    5,255
460 DATA255,255,255,255,255,255,255,255,
    255,255,255,255,255,255,255,255,255,
    255
470 DATA255,255,255,255,255,255,255,255,
    255,255
```

```
480 V=53248
490 FORI=832TO894:READJ:POKEI,J:NEXT
500 FORK=834+64TO892+66:READL:POKEK,L:NE
    XT:POKE2Ø41,14:POKEV+4Ø,6
510 POKE2Ø4Ø,13:POKEV+39,2:POKEV,15Ø:POK
    EV+1,2ØØ
520 IFPEEK(49152)<>173THENGOSUB1Ø5Ø
530 POKEV+3,191
540 IFHI<7ØTHENHI=59
550 TH=1:GOSUB13Ø
560 POKEV+2,PEEK(V):POKEV+21,255
570 FORG=V+5TO V+15STEP2:POKEG,HI:NEXT
580 SYS49658
590 DATAØ
600 DATAØ,Ø,Ø,Ø,Ø,Ø,3,255,24Ø,3,63,48,3,
    51,48,3,243,24Ø,3,63,48,3,2Ø4,24Ø,3,
    243
```



The balloons in the 64 version of "Blockhead" float across the screen.

```
610 DATA24Ø,3,255,24Ø,Ø,127,128,127,243,
    255,127,255,255,255,255,255,128,115
620 DATA128,Ø,127,128,Ø,127,128,Ø,251,19
    2,1,241,224,3,224,24Ø,7,192,12Ø
630 IF(PEEK(56321)AND4)<>ØTHEN79Ø
640 X2=Ø:POKE49829,Ø
650 FORT=(PEEK(V+3))TO5ØSTEP-4:POKEV+3,T
660 IFPEEK(V+3Ø)>3THENPOKEV+21,(PEEK(V+2
    1)ANDNOT(PEEK(V+3Ø))):SC=SC+1Ø:GOSUB
    31Ø
670 POKE(V+21),(PEEK(V+21)OR3)
680 NEXT:GOTO7ØØ
690 GOTO79Ø
700 POKE49829,Ø
710 FORJ=(PEEK(V+3))TO255STEP1Ø:POKEV+3,
    J:IFPEEK(49829)=3THENX2=1:GOTO79Ø
720 PI=INT(RND(Ø)*4Ø)-2Ø:IF(PEEK(5325Ø)+
    PI)<6ØAND(PEEK(53264)AND2)=ØTHENPI=Ø
730 IF(PEEK(V+2)+PI)<5ØAND(PEEK(V+16)AND
    2)=ØORPEEK(V+2)>254THENPI=Ø
740 IF(PEEK(53264)AND2)<>ØAND(PEEK(5325Ø
    )+PI)>2ØTHENPI=Ø
750 IF PEEK(5325Ø)+PI<245AND PEEK(5325Ø)
    +PI>1ØTHENPOKE5325Ø,PEEK(5325Ø)+PI
760 IFPEEK(V+3)<2Ø1THEN78Ø
770 PRINT"{HOME}{3 DOWN}{7 RIGHT}OOPS!"
    :SC=SC-5:FORT=1TO1ØØ:NEXT:PRINT"
    {HOME}{7 RIGHT}{3 DOWN}{5 SPACES}"
780 NEXT
790 IF PEEK(V+21)=3THEN:HI=HI-15:POKEV+3
    ,19Ø:GOTO53Ø
800 IFX2=1ANDPEEK(V+3)>18ØTHENPOKEV+3,19
    Ø
810 P=INT(RND(Ø)*4Ø)-2Ø:IFPEEK(5325Ø)+P<
    15THENP=Ø
820 PRINT"{HOME}{15 RIGHT}SCORE";"
    {5 SPACES}";
830 PRINT"{HOME}{15 RIGHT}SCORE";SC
840 IFVAL(TI$)>59ØØTHENTI$="ØØØØØØ"
850 IFTI$>="ØØØ2ØØ"THEN87Ø
860 PRINT"{HOME}{DOWN}{3 RIGHT}TIME ";RI
    GHT$(TI$,4);"{HOME}{DOWN}{3 RIGHT}TI
    ME ";:GOTO63Ø
870 PRINT"{HOME}{15 RIGHT}{8 DOWN}GAME O
    VER":POKE198,Ø
880 PRINT"{HOME}{DOWN}{3 RIGHT}TIME ";RI
    GHT$(TI$,4);"{HOME}{DOWN}{3 RIGHT}TI
    ME ";
890 PRINT"{HOME}{1Ø RIGHT}{1Ø DOWN}PLAY
    AGAIN? Y OR N "
900 IFPEEK(197)=25THENCLR:RESTORE:GOTO11
    Ø
910 IFPEEK(197)=39THENSYS2Ø48
920 GOTO89Ø
930 PRINT"";:FORBO=1Ø24TO1984STEP4Ø:POK
    EBO,224:POKEBO+39,224
940 POKEBO+54272,2:POKEBO+54311,2
950 POKEBO+1,224:POKEBO+38,224
960 POKEBO+1+54272,4:POKEBO+5431Ø,4
970 POKEBO+2,224:POKEBO+37,224
980 POKEBO+2+54272,15:POKEBO+543Ø9,15
990 NEXT
1000 FORFL=1864TO2Ø23:POKEFL,224:POKEFL+
     54272,8:NEXT
1010 TI$="235952"
1020 FORTE=1Ø25TO1Ø62:POKETE,224:POKETE+
     54272,3:NEXT
1030 POKE5328Ø,1
1040 RETURN
1050 POKEV+21,Ø:FORV1=49152TO49673:READJ
     2:POKEV1,J2:NEXT:RETURN
1060 DATA 173, 25, 212, 73, 255, 141, 16
     4, 194
1070 DATA 216, 24, 173, 164, 194, 1Ø5, 4
     Ø, 141
1080 DATA 161, 194, 56, 173, 164, 194, 2
     33, 215
1090 DATA 141, 162, 194, 173, 164, 194,
     2Ø1, 216
1100 DATA 176, 17, 173, 161, 194, 141, 1
     63, 194
1110 DATA 173, 16, 2Ø8, 41, 254, 141, 16
     , 2Ø8
1120 DATA 76, 65, 192, 173, 16, 2Ø8, 9, 1
1130 DATA 141, 16, 2Ø8, 173, 162, 194, 1
     41, 163
1140 DATA 194, 173, 163, 194, 141, Ø, 2Ø
     8, 173
1150 DATA 3Ø, 2Ø8, 141, 16Ø, 194, 24Ø, 3
     , 141
1160 DATA 165, 194, 173, 16Ø, 194, 41, 1
     , 24Ø
1170 DATA 23, 169, 19Ø, 173, 163, 194, 1
     41, 2
1180 DATA 2Ø8, 173, 16, 2Ø8, 41, 1, 141,
     6
1190 DATA 2Ø2, 1Ø, 13, 6, 2Ø2, 141, 16,
     2Ø8
```

```
1200 DATA 173, 16, 202, 56, 233, 210, 14
     1, 17
1210 DATA 202, 173, 16, 202, 24, 105, 45
     , 141
1220 DATA 18, 202, 173, 16, 202, 201, 21
     0, 176
1230 DATA 17, 173, 16, 208, 41, 251, 141
     , 16
1240 DATA 208, 173, 18, 202, 141, 4, 208
     , 76
1250 DATA 168, 192, 173, 16, 208, 9, 4,
     141
1260 DATA 16, 208, 173, 17, 202, 141, 4,
     208
1270 DATA 173, 19, 202, 56, 233, 210, 14
     1, 20
1280 DATA 202, 173, 19, 202, 24, 105, 45
     , 141
1290 DATA 21, 202, 173, 19, 202, 201, 21
     0, 176
1300 DATA 17, 173, 16, 208, 41, 247, 141
     , 16
1310 DATA 208, 173, 21, 202, 141, 6, 208
     , 76
1320 DATA 224, 192, 173, 16, 208, 9, 8,
     141
1330 DATA 16, 208, 173, 20, 202, 141, 6,
     208
1340 DATA 173, 22, 202, 56, 233, 210, 14
     1, 23
1350 DATA 202, 173, 22, 202, 24, 105, 45
     , 141
1360 DATA 24, 202, 173, 22, 202, 201, 21
     0, 176
1370 DATA 17, 173, 16, 208, 41, 239, 141
     , 16
1380 DATA 208, 173, 24, 202, 141, 8, 208
     , 76
1390 DATA 24, 193, 173, 16, 208, 9, 16,
     141
1400 DATA 16, 208, 173, 23, 202, 141, 8,
     208
1410 DATA 173, 25, 202, 56, 233, 210, 14
     1, 26
1420 DATA 202, 173, 25, 202, 24, 105, 45
     , 141
1430 DATA 27, 202, 173, 25, 202, 201, 21
     0, 176
1440 DATA 17, 173, 16, 208, 41, 223, 141
     , 16
1450 DATA 208, 173, 27, 202, 141, 10, 20
     8, 76
1460 DATA 80, 193, 173, 16, 208, 9, 32,
     141
1470 DATA 16, 208, 173, 26, 202, 141, 10
     , 208
1480 DATA 173, 28, 202, 56, 233, 210, 14
     1, 29
1490 DATA 202, 173, 28, 202, 24, 105, 45
     , 141
1500 DATA 30, 202, 173, 28, 202, 201, 21
     0, 176
1510 DATA 17, 173, 16, 208, 41, 191, 141
     , 16
1520 DATA 208, 173, 30, 202, 141, 12, 20
     8, 76
1530 DATA 136, 193, 173, 16, 208, 9, 64,
     141
1540 DATA 16, 208, 173, 29, 202, 141, 12
     208
1550 DATA 173, 31, 202, 56, 233, 210, 14
     1, 32
1560 DATA 202, 173, 31, 202, 24, 105, 45
     , 141
1570 DATA 33, 202, 173, 31, 202, 201, 21
     0, 176
1580 DATA 17, 173, 16, 208, 41, 127, 141
     , 16
1590 DATA 208, 173, 33, 202, 141, 14, 20
     8, 76
1600 DATA 192, 193, 173, 16, 208, 9, 128
     , 141
1610 DATA 16, 208, 173, 32, 202, 141, 14
     , 208
1620 DATA 238, 16, 202, 238, 16, 202, 24
     , 173
1630 DATA 16, 202, 105, 43, 141, 19, 202
     , 173
1640 DATA 19, 202, 105, 43, 141, 22, 202
     , 173
1650 DATA 22, 202, 105, 43, 141, 25, 202
     , 173
1660 DATA 25, 202, 105, 43, 141, 28, 202
     , 173
1670 DATA 28, 202, 105, 43, 141, 31, 202
     , 173
1680 DATA 30, 208, 240, 3, 141, 160, 194
     , 76
1690 DATA 49, 234, 120, 169, 0, 141, 20,
     3
1700 DATA 169, 192, 141, 21, 3, 88, 96,
     0
1710 DATA 255, 255, 0, 0, 255, 255, 0, 0
```

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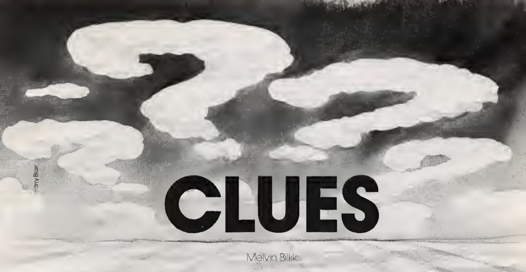


Larry Blair

CLUES

Melvin Billik

An excellent teaching tool for preschoolers on up – with options to tailor the program for different age groups. For TI-99/4A and all Commodore computers.

As a teacher-administrator, I have found my PET extremely useful in creating programs for courses I teach, such as BASIC Programming and Statistics. In addition, other programs help me with administrative tasks, such as grading, transcript evaluation, teacher scheduling, and attendance.

However, as a parent of two preschoolers, I get the most satisfaction from writing programs for them. One such program is "Clues." It is fairly simple and can easily be modified for other microcomputers.

The youngster is asked his or her name, followed by a series of questions. A correct response by my son will yield a flashing message, "OKAY – GREAT, KEITH!" For an incorrect response, the question will be repeated. For two consecutive incorrect responses, the answer will be given and a new question will be asked.

For the Commodore version, the data is listed (question first, then answer) from line 700 on up. Line 1, the DIM statement, sets a maximum of 200 questions and answers. You can change this as your computer's memory size dictates. The program itself counts the number of questions and answers. Note the flag in line 1940.

Modifications

The program picks the questions at random. However, you can easily adjust the program so that no question is asked more than once by adding a new array variable as a flag (a value of 0 indicates the question has not yet been asked). For the Commodore version, add:

```
1  DIM C$(200), CA$(200), FL(200)
45 IF FL(X%)<>0 THEN 40
55 FL(X%)=1
```

As more and more questions are asked, program execution time is slowed considerably (as the program searches for unasked questions). However, as long as you've asked less than 90 percent of your available questions, time delay is not a problem.

The game will continue until the player decides to quit, either by pressing the RETURN key in response to a question or by turning off the machine. If you made the previous program modification, the game can continue until all the questions have been asked. You can modify the Commodore version of the program to ask a specific number of questions as follows:

```
230 PRINT "HOW MANY QUESTIONS, MAX
    OF ";N
240 INPUT NQ: IF NQ>N THEN 230
250 RETURN
19  FOR II=1 TO NQ
70  IF A$= CA$(X%) THEN I=10:GOSUB 500:
    GOTO 100
100 NEXT II
```

You can also adjust the level of questions to be suitable for a user's educational level. The subroutine starting in line 500 of the Commodore version, while exciting for a preschooler, might not be appropriate for an older child. An alternative might be to include a number of cute sayings and print one at random for a correct response. For example, we can replace the subroutine with:

```
500 Z=INT(3*RND(TI)+1)
510 ON Z GOSUB 520,530,540
515 FOR I=1 TO 1000: NEXT
519 PRINT "CLR": RETURN
520 PRINT "NOT BAD"
525 RETURN
530 PRINT "BET YOU CAN'T DO IT AGAIN"
535 RETURN
540 PRINT "BOY, ARE YOU LUCKY TODAY!"
545 RETURN
```

Also, Clues can be a good teaching tool: you can store a few hundred questions and using the modifications, generate a 10-25 question quiz. No two students would have the same quiz.

> **BEFORE TYPING...**
> **If you're new to computing, please read "How To Type COMPUTE!'s Programs" and "A Beginner's Guide To Typing In Programs."**

Program 1: Clues – TI Version

```
90 RESTORE
100 RANDOMIZE
110 DIM C$(201)
111 DIM CA$(201)
120 GOSUB 440
130 CALL CLEAR
140 CALL SCREEN(5)
150 INPUT "WHAT IS YOUR NAME?":N$
160 PRINT ::
170 CALL CLEAR
180 PRINT "OKAY, ";N$;" USE THE FOLL
    OWING CLUE"
190 PRINT "TO SPELL THE WORD"
200 I=0
210 XE=INT(N*RND+1)
250 PRINT ::
260 PRINT C$(XE)
270 INPUT A$
280 IF A$<>CA$(XE)THEN 320
290 I=10
300 GOSUB 510
310 GOTO 160
320 I=I+1
330 IF I<>1 THEN 370
340 PRINT "NO, ";N$;
350 PRINT " TRY AGAIN"
360 GO TO 270
370 IF I<>2 THEN 410
380 PRINT "NO, ";N$
390 PRINT "THE CORRECT ANSWER WAS ";
400 PRINT CA$(XE)
410 FOR M=1 TO 1000
420 NEXT M
430 GOTO 170
440 FOR K=1 TO 200
450 READ C$(K)
460 IF C$(K)<>"END" THEN 485
470 N=K-1
480 K=200
482 GOTO 490
485 READ CA$(K)
490 NEXT K
500 RETURN
510 FOR I=1 TO 11
520 CALL CLEAR
530 PRINT TAB(10)
540 PRINT ::
550 PRINT "OKAY GREAT--";N$
560 FOR T=1 TO 50
570 NEXT T
580 NEXT I
590 RETURN
600 DATA YOUR DAD'S NAME IS
610 DATA MEL
620 DATA YOUR SISTER'S NAME IS
630 DATA TARA
640 DATA YOUR MOM'S NAME IS
650 DATA CHERYL
660 DATA YOUR DOG'S NAME IS
670 DATA BRANDY
680 DATA THE OPPOSITE OF YES IS
690 DATA NO
700 DATA SOMETHING YOU SLEEP ON
710 DATA BED
720 DATA SOMETHING YOUR DOG LIKES TO
     CHEW ON
730 DATA BONE
740 DATA WHERE YOU LEAVE A STORE OR
    {4 SPACES}RESTAURANT THE SIGN SA
    YS
750 DATA EXIT
760 DATA SOMETHING YOU LIKE TO CHEW
765 DATA GUM
770 DATA WHAT DOES A CRANKY KID DO
780 DATA CRY
790 DATA HOW MANY FINGERS DO YOU HAV
    E?
800 DATA TEN
810 DATA END
```

Program 2: Clues — For All Commodore Computers

```
1 DIM C$(200),CA$(200)
10 X= RND(-TI)
15 GOSUB 200
18 INPUT "{CLR}WHAT IS YOUR NAME";N$
20 PRINT:PRINT "{CLR}OKAY, ";N$;", USE T
   HE FOLLOWING CLUE
30 PRINT"TO SPELL THE WORD."
40 I=0:X%= N*RND(TI)+1
50 PRINT:PRINT:PRINTC$(X%)
60 PRINT:PRINT:INPUT A$
70 IF A$= CA$(X%) THEN I =10:GOSUB 500:G
   OTO 20
80 I=I+1: IF I=1 THEN PRINT:PRINT"NO, ";
   N$;" TRY AGAIN":GOTO 60
90 IF I = 2 THEN PRINT"NO, ";N$;", THE C
   ORRECT ANSWER":PRINT"WAS "; CA$(X%)
97 FOR M = 1 TO 3500:NEXT
100 GOTO 20
200 FOR I = 1 TO 200
210 READ C$(I)
212 IF C$(I) ="END" THEN N=I-1:GOTO 230
215 READ CA$(I)
220 NEXT
230 RETURN
500 FOR I = 1 TO 11
505 PRINT"{CLR}"{2 SPACES}: FOR J = 1 TO
    100:NEXT
510 PRINT"{12 DOWN}{10 RIGHT}OKAY--GREAT
    , ";N$
520 FOR J = 1 TO100:NEXT J
530 NEXT I
540 RETURN
600 PRINT"{CLR}{7 DOWN}"
700 DATA YOUR DAD'S NAME IS
710 DATA MEL
```

AARDVARK L.T.D.

TRS-80 COLOR COMMODORE 64 VIC-20 SINCLAIR/TIMEX TI99/4A

QUEST -- A NEW IDEA IN ADVENTURE GAMES! Different from all the others. Quest is played on a computer generated map of Alesia. Your job is to gather men and supplies by combat, bargaining, exploration of ruins and temples and outright banditry. When your force is strong enough, you attack the Citadel of Moorlock in a life or death battle to the finish. Playable in 2 to 5 hours, this one is different every time. TRS-80 Color, and Sinclair, 13K VIC-20. Extended BASIC required for TRS-80 Color and TI99/A. $14.95 each.

32K TRS 80 COLOR Version $24.95. Adds a second level with dungeons and more Questing.

WIZARDS TOWER — This is very similar to Quest (see above). We added wizards, magic, dragons, and dungeons to come up with a Quest with a D&D flavor. It requires 16k extended color BASIC. 13k VIC, Commodore 64, TRS-80 16k Extended BASIC, TI99/A extended BASIC. $14.95 Tape, $19.95 Disk.

Authors — Aardvark pays the highest commissions in the industry and gives programs the widest possible advertising coverage. Send a Self Addressed Stamped Envelope for our Authors Information Package.

ZEUS — It's fast and furious as you become the **WIZARD** fighting off the Thurderbolts of an angry **ZEUS**. Your Cone of Cold will destroy a thunderbolt and your shield will protect you — for a while. This is the best and highest speed arcade action we have ever done. Difficulty increases in wave after wave, providing hours of challenging fun and a game that you may never completely master. Commodore 64, Vic20 (16k expander), and 16k TRS-80 Color Computer. (ALL MACHINE CODE!)
$19.95 tape $24.95 disk. (Tape will not transfer to disk.)

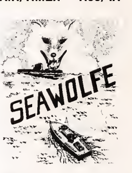
ADVENTURES!!!

The Adventures below are written in BASIC, are full featured, fast action, full plotted adventures that take 30-50 hours to play. (Adventures are interactive fantasies. It's like reading a book except that you are the main character as you give the computer, commands like "Look in the Coffin" and "Light the torch.")

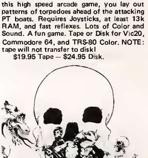
Adventuring requires 16k on Sinclair, and TRS-80 Color. They require 8k on OSI and 13k on VIC-20. Now available for TI99. Any Commodore 64.
$14.95 Tape — $19.95 Disk.

ESCAPE FROM MARS
(by Rodger Olsen)
This ADVENTURE takes place on the RED PLANET. You'll have to explore a Martian city and deal with possibly hostile aliens to survive this one. A good first adventure.

PYRAMID (by Rodger Olsen)
This is our most challenging ADVENTURE. It is a treasure hunt in a pyramid full of problems. Exciting and tough!



SEAWOLFE — ALL MACHINE CODE In this high speed arcade game, you lay out patterns of torpedoes ahead of the attacking PT boats. Requires Joysticks, at least 13k RAM, and fast reflexes. Lots of Color and Sound. A fun game. Tape or Disk for Vic20, Commodore 64, and TRS-80 Color. NOTE: tape will not transfer to disk!
$19.95 Tape — $24.95 Disk.



Dungeons of Death — This is the first D&D type game good enough to qualify at Aardvark. This is serious D&D that allows 1 to 6 players to go on a Dragon Hunting, Monster Killing, Dungeon Exploring Quest. Played on an on-screen map, you get a choice of race and character (Human, Dwarf, Soldier, Wizard, etc.), a chance to grow from game to game, and a 15 page manual. 16k Extended TRS-80 Color, 13k VIC, Commodore 64. At the normal price for an Adventure (14.95 tape, $19.95 disk), this is a giveaway.

Dealers — We have a line of about 100 original programs for the machines listed here. We have High speed Arcades, Quality Adventures, Word processors and Business Software for Small machines. Better yet, we have excellent Dealer support. Phone for information.

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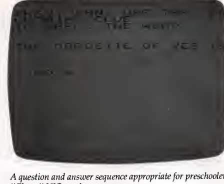
```
720 DATA YOUR NAME IS
730 DATA KEITH
740 DATA YOUR SISTER'S NAME IS
750 DATA TARA
760 DATA YOUR MOM'S NAME IS
770 DATA CHERYL
780 DATA YOUR DOG'S NAME IS
790 DATA BRANDY
800 DATA THE OPPOSITE OF YES IS
810 DATA NO
820 DATA SOMETHING YOU SLEEP ON
830 DATA BED
840 DATA SOMETHING YOUR DOG LIKES TO CHE
    W ON
850 DATA BONE
860 DATA WHERE YOU LEAVE A STORE OR REST
    AURANT{3 SPACES}THE SIGN SAYS
870 DATA EXIT
900 DATA SOMETHING YOU LIKE TO CHEW
910 DATA GUM
920 DATA WHAT DOES A CRANKY KID DO
930 DATA CRY
940 DATA HOW MANY FINGERS DO YOU HAVE?
950 DATA TEN
1940 DATA{3 SPACES}END
```

Program 3:
Clues – Program Adjustment For VIC Version

Change this line of the Commodore version for use with VIC-20.

```
510 PRINT "{10 DOWN}{2 RIGHT}OKAY--GREAT
     ";N$
```



A question and answer sequence appropriate for preschoolers. "Clues," VIC version.

©

Gold Miner For TI-99/4A

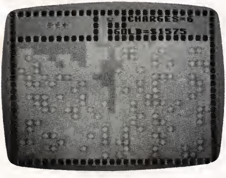
James Dunn

Dig your way into the Lost Mine and search for gold in this exciting TI-99/4A translation of a game first published in **COMPUTE!**, *July 1982.*

"Gold Miner" will run in TI BASIC, using about 5K. It won't run in Extended BASIC because of the character definition using ASCII 144 and above.

Most of the program was translated quite easily from Joseph Weber's original VIC-20 version except for formatting the display of the score and the charges. Extended BASIC contains commands to display at any position on the screen. But TI BASIC will print only at the bottom of the screen, which scrolls the whole display up. Since I wanted this program to run in TI BASIC, I had to use string manipulation to format the score and charges using their ASCII representations. Then, using HCHAR, printing at specific screen locations was possible without disturbing the rest of the display (see lines 1450-1640).

The only other modification is to the main character. I designed a small pick-ax to represent the miner, and animated it, so it would seem to chop its way into the mine. This is done in the main loop, lines 640 - 660, and slows execution only slightly. But it doesn't matter in this game because speed is unimportant. In fact, you can walk away from the game, come back an hour later, and take up where you left off.



Digging for golden nuggets in the TI version of "Goldminer."

One other point: You must hold down the key, joystick, or fire button until the program calls the routine to read the input. It makes the joystick a bit awkward, but this doesn't affect the game because reflex time is unimportant with "Gold Miner."

BEFORE TYPING...
If you're new to computing, please read "How To Type COMPUTE!'s Programs" and "A Beginner's Guide To Typing In Programs."

Gold Miner For TI-99/4A

```
50 REM  INITIALIZE
60 CALL CLEAR
70 GOSUB 730
80 GOSUB 880
90 M=4
100 S=0
110 W=0
120 GO SUB 1090
130 T=250
140 REM  MAIN LOOP
150 CALL HCHAR(B,A,32)
160 IF X=4 THEN 210
170 IF X=-4 THEN 230
180 IF Y=4 THEN 300
190 IF Y=-4 THEN 320
200 GOTO 460
210 A=A+1
220 GOTO 390
230 A=A-1
240 CALL GCHAR(B,A,Q)
250 IF Q=126 THEN 280
260 IF Q=35 THEN 280
270 GOTO 460
280 A=A+1
290 GOTO 600
300 B=B-1
310 GOTO 430
320 B=B+1
330 CALL GCHAR(B,A,Q)
340 IF Q=126 THEN 370
350 IF Q=35 THEN 370
360 GOTO 460
370 B=B-1
380 GOTO 600
390 CALL GCHAR(B,A,Q)
400 IF Q<>35 THEN 460
410 A=A-1
420 GOTO 460
430 CALL GCHAR(B,A,Q)
440 IF Q<>35 THEN 460
```

```
450 B=B+1
460 CALL GCHAR(B,A,Q)
470 IF Q=126 THEN 520
480 IF Q=152 THEN 580
490 IF Q=144 THEN 540
500 IF Q=136 THEN 560
510 GOTO 600
520 GO SUB 2140
530 GOTO 600
540 S=S+1
550 GOTO 600
560 GO SUB 1650
570 GOTO 600
580 S=S+1
590 CALL SOUND(50,4000,0)
600 IF RV<>18 THEN 640
610 GOSUB 1810
620 GOSUB 2190
630 GO SUB 1450
640 FOR Z=128 TO 131
650 CALL HCHAR(B,A,Z)
660 NEXT Z
670 CALL SOUND(100,200,0)
680 GO SUB 1020
690 IF C<1 THEN 710
700 GOTO 150
710 GOSUB 2390
720 GOTO 150
730 REM  DEF SP CHARS
740 CALL CHAR(126,"AA55AA55AA55AA55"
    )
750 CALL COLOR(12,15,1)
760 CALL CHAR(152,"00183C7E7E3C1800"
    )
770 CALL COLOR(16,12,1)
780 CALL CHAR(136,"000000E742427E18"
    )
790 CALL COLOR(14,13,1)
800 CALL CHAR(144,"00107C1010101010"
    )
810 CALL COLOR(15,2,1)
820 CALL CHAR(128,"3854921010000000"
    )
830 CALL CHAR(129,"000402011F010204"
    )
840 CALL CHAR(130,"0000001010925438"
    )
850 CALL CHAR(131,"204080F880402000"
    )
860 CALL COLOR(13,5,1)
870 RETURN
880 REM  PRINT INSTRUCTIONS
890 PRINT TAB(9);"GOLD MINER"
900 PRINT :::
910 PRINT TAB(4);CHR$(131);"= MINER"
    ::
920 PRINT TAB(4);CHR$(152);"= GOLD":
    :
930 PRINT TAB(4);CHR$(144);"= DEAD M
    INER"::
940 PRINT TAB(4);CHR$(126);"= DIRT":
    :
950 PRINT TAB(4);CHR$(136);"= ASSAY
    OFFICE":::
960 PRINT "USE FIRE BUTTON TO BLAST"
    ::
970 PRINT "HIT ANY KEY TO PLAY":::
980 CALL KEY(3,RV,ST)
990 IF ST=0 THEN 980
1000 CALL CLEAR
1010 RETURN
1020 REM  CHECK JOY STICK
1030 CALL JOYST(2,X,Y)
1040 IF ABS(X)+ABS(Y)=4 THEN 1070
1050 X=0
1060 Y=0
1070 CALL KEY(2,RV,SV)
1080 RETURN
1090 REM  DRAW BOARD
1100 CALL HCHAR(1,3,35,28)
1110 CALL HCHAR(5,4,35,11)
1120 CALL HCHAR(5,16,35,14)
1130 CALL HCHAR(24,4,35,26)
1140 CALL VCHAR(1,3,35,24)
1150 CALL VCHAR(1,30,35,24)
1160 CALL VCHAR(2,14,35,3)
1170 CALL VCHAR(3,16,35,2)
1180 CALL VCHAR(3,17,35)
1190 CALL VCHAR(2,18,35,2)
1200 FOR X=6 TO 23
1210 CALL HCHAR(X,4,126,26)
1220 NEXT X
1230 FOR GL=1 TO 180
1240 RANDOMIZE
1250 X=RND*25+4
1260 Y=RND*17+6
1270 CALL HCHAR(Y,X,152)
1280 NEXT GL
1290 REM
1300 GOSUB 1340
1310 GOSUB 1450
1320 CALL HCHAR(6,4,32,12)
1330 RETURN
1340 REM  PLACE MINERS
1350 IF M<1 THEN 2570
1360 CALL HCHAR(3,7,32,5)
1370 CALL HCHAR(3,8,131,M-1)
1380 CALL HCHAR(4,15,131)
1390 C=10
1400 S=0
1410 CALL HCHAR(2,16,136)
1420 A=15
1430 B=4
1440 RETURN
1450 REM  PRINT SCORE/CHARGES
     {5 SPACES}
1460 A$="CHARGES="
1470 FOR I=0 TO 7
1480 B$=SEG$(A$,I+1,1)
1490 CALL HCHAR(2,19+I,ASC(B$))
1500 NEXT I
1510 FOR I=0 TO LEN(STR$(C))-1
1520 CG$=SEG$(STR$(C),I+1,1)
1530 CALL HCHAR(2,27+I,ASC(CG$))
1540 NEXT I
1550 A$="GOLD=$"
1560 FOR I=0 TO 5
1570 B$=SEG$(A$,I+1,1)
1580 CALL HCHAR(4,17+I,ASC(B$))
1590 NEXT I
1600 FOR I=0 TO LEN(STR$(W))-1
1610 SC$=SEG$(STR$(W),I+1,1)
1620 CALL HCHAR(4,23+I,ASC(SC$))
1630 NEXT I
1640 RETURN
1650 REM  TALLY GOLD
1660 CALL HCHAR(2,19,32,11)
1670 CALL HCHAR(4,17,32,13)
1680 CALL SOUND(1,500,0)
1690 FOR DELAY=1 TO 5
1700 NEXT DELAY
1710 CALL SOUND(1,500,0)
1720 C1=C
1730 IF C1<>0 THEN 1750
```

```
1740 C1=1
1750 W=S*C1+W
1760 M=M-1
1770 GOSUB 1340
1780 GO SUB 1450
1790 CALL HCHAR(2,4,32,10)
1800 RETURN
1810 REM  EXPLOSION
1820 CALL HCHAR(B,A,131)
1830 FOR I=0 TO 30 STEP 5
1840 CALL SOUND(100,-5,1)
1850 NEXT I
1860 CALL GCHAR(B+1,A,Q)
1870 IF Q=35 THEN 1890
1880 CALL HCHAR(B+1,A,88)
1890 CALL GCHAR(B-1,A,Q)
1900 IF Q=35 THEN 1920
1910 CALL HCHAR(B-1,A,88)
1920 CALL GCHAR(B,A+1,Q)
1930 IF Q=35 THEN 1950
1940 CALL HCHAR(B,A+1,88)
1950 CALL GCHAR(B,A-1,Q)
1960 IF Q=35 THEN 1980
1970 CALL HCHAR(B,A-1,88)
1980 REM
1990 CALL GCHAR(B+1,A,Q)
2000 IF Q=35 THEN 2020
2010 CALL HCHAR(B+1,A,32)
2020 CALL GCHAR(B-1,A,Q)
2030 IF Q=35 THEN 2050
2040 CALL HCHAR(B-1,A,32)
2050 CALL GCHAR(B,A+1,Q)
2060 IF Q=35 THEN 2080
2070 CALL HCHAR(B,A+1,32)
2080 CALL GCHAR(B,A-1,Q)
2090 IF Q=35 THEN 2110
2100 CALL HCHAR(B,A-1,32)
2110 C=C-1
2120 CALL HCHAR(2,19,32,11)
2130 RETURN
2140 REM  SFX EXPLOSION
2150 FOR I=0 TO 30 STEP 5
2160 CALL SOUND(20,-1,I)
2170 NEXT I
2180 RETURN
2190 REM  CAVE IN
2200 FOR I=1 TO 10
2210 RANDOMIZE
2220 B1=INT(RND*17)+6
2230 A1=INT(RND*25)+4
2240 CALL GCHAR(B1,A1,Q)
2250 IF Q=152 THEN 2280
2260 IF Q=131 THEN 2300
2270 CALL HCHAR(B1,A1,126)
2280 NEXT I
2290 RETURN
2300 GOSUB 2330
2310 RV=0
2320 GO TO 150
2330 REM  SQUASH MINER
2340 M=M-1
2350 CALL HCHAR(B,A,144)
2360 S1=S
2370 GOSUB 1340
2380 RETURN
2390 REM  GET OUT COUNTER
2400 IF T<128 THEN 2500
2410 A$="GET OUT"
2420 FOR I=0 TO 6
2430 B$=SEG$(A$,I+1,1)
2440 CALL HCHAR(2,4+I,ASC(B$))
2450 NEXT I
2460 CALL SOUND(-50,300,0)
2470 T=T-4
2480 RV=0
2490 RETURN
2500 CALL HCHAR(B,A,32)
2510 M=M-1
2520 IF M=0 THEN 2570
2530 GOSUB 1340
2540 GOSUB 1450
2550 CALL HCHAR(2,4,32,10)
2560 GOTO 130
2570 REM  PLAY AGAIN LOOP
2580 GO SUB 1450
2590 FOR DELAY=1 TO 2000
2600 NEXT DELAY
2610 CALL CLEAR
2620 PRINT "PLAY AGAIN?"
2630 PRINT "Y OR N"
2640 CALL KEY(3,X,ST)
2650 IF ST=0 THEN 2640
2660 IF X=89 THEN 90
2670 IF X=78 THEN 2690
2680 GOTO 2610
2690 CALL CLEAR
2700 END
```

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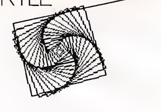
FRIENDS OF THE TURTLE



David D Thornburg, Associate Editor

Travels With TOPO

The San Diego CUE (Computer Using Educators) conference was one speaking engagement I looked forward to with eager anticipation. My talk was on the use of robots in the classroom, and Androbot's TOPO was my star attraction. (If you don't know about TOPO, see the "Friends of the Turtle" and "Computers and Society" columns in the May 1983 issue of **COMPUTE!**.) Since I like to travel light, I had arranged for TOPO to be sent ahead of me to the hotel.

A few hours before my scheduled departure, I found that TOPO was not going to be delivered as scheduled and that it had to travel on the plane with me.

My frantic call to the airline went something like this:

"PSA reservations. May I help you?"

"Yes, I need another round-trip ticket between San Jose and San Diego."

"Of course, and the passenger's last name, please?"

"TOPO."

"Fine, his first name please?"

I paused. What was his first name?

"Uh, Peter."

"Thank you. Is Peter a child?"

"Uh, Peter is under six."

"Excellent! He can travel for half fare."

"Good. Oh, by the way, there is something I think you should know."

"What's that?"

"Uh, Peter isn't human."

This time it was the agent who paused.

"Is it a dog?"

"No, it's a robot."

"A robot! How exciting! I'll make sure the airport personnel know to expect him."

And thus began an adventure that will be commonplace in a few years – taking the domestic robot on a trip.

We arrived at the airport with time to spare, picked up TOPO's ticket, and went through X-ray without a hitch. The response of other passengers was quite varied. One woman looked at TOPO, clasped her hands, and said, "I think I'm in love!" A four-year-old moppet named Alison approached TOPO with hesitation, but by the end of the trip she and TOPO were great friends.

The stewardess asked what TOPO would like to drink.

"WD-40 on the rocks," I replied.

Although TOPO was the subject of much attention, one can envision such scenes becoming commonplace in the not too distant future. And as domestic robots become more common, software will be developed to make them more useful. Today, TOPO is a tremendously valuable tool for education. By controlling TOPO through Logo's turtle graphics commands, children become highly motivated to learn programming. In the future we can expect ever more sophisticated programs to be developed around practical applications.

Whether TOPO or its offspring vacuum carpets, mow the lawn, watch the kids, or help carry groceries, it is clear to me that domestic robots will soon become as common as personal computers. As a result, we can expect the airlines to offer special seating (robot class?) in which our mechanical companions can travel together, perhaps getting recharged during their travel time. When this happens, we will know that the age of robotics has arrived.

Notes From All Over

The use of Logo with children has been the subject of university research since the language was developed. Dennis Harper at the University of California at Santa Barbara has a research project with a new twist. He is embarking on a special project in Papua, New Guinea, to teach PILOT and Logo to teachers. With the assistance of the government of New Guinea and the use of equipment supplied by Atari, Dennis will be studying the use of Atari PILOT and Logo by teachers who have, in many cases, only elementary educations themselves. The fact that some of these teachers will not have seen a television before should make their response to turtle graphics quite interesting.

Mr. Harper has quite a few objectives to accomplish during this project. He will be demonstrating existing computer-aided instructional materials, and will then let the teachers learn both Logo and PILOT. He hopes to see what effect the computer will have on positive attitudes toward technology, increased literacy, teacher training, effectiveness in teaching, the dropout rate, the overproduction of humanities graduates, indigenous research and development efforts, and discrimination in primary schools.

In his research proposal Mr. Harper states:

> Whether or not logical thinking among the students will increase by learning programming will be part of these observations. Although such gains are assumed almost as a cultural truism, there is a paucity of research either supporting or not justifying that hypothesis. The lack of empirical testing of cognitive gains following computer training is understandable and results from the fact that much research dealing with Logo has been constrained until recently by expensive hardware and small, non-equivalent controls.

I expect that Dennis will have some interesting observations to share with us, and look forward to hearing reports from the field.

Chuck E. Cheese Learns Logo

I dropped into my local Pizza Time Theater last night and was quite pleasantly surprised to see a half-dozen Apple computers being used to teach Logo to members of the Pizza Time Theater computer club. This step-up from the arcade games comes as a pleasant rejoinder to those who claim that such places have no redeeming social value. I haven't found out if this is a purely local phenomenon, but I endorse the idea of locating computer clubs in pizza parlors and arcades and would like to hear from those of you who have seen or used such facilities in your area.

A Final Note

Some of you may have guessed that I am a technology junkie. Well, you are right. I have composed this entire column on a word processor that sits on my lap as I rest under a tree in the middle of a park. I have been using the Radio Shack Model 100 computer, and it has been working beautifully. I may write a review on it for the next issue. Meanwhile, keep those cards and letters coming.

Send me your turtle graphics discoveries so we can share them with other Friends of the Turtle! ©

Glenn M Kleiman

After The Basics Of BASIC...

One of the questions I'm often asked is: "What do I do after I've learned the basics of BASIC?" Many people have taken introductory classes or read books about BASIC programming. They have mastered using PRINT, INPUT, GOTO, FOR-NEXT, IF-THEN, and other commands of the BASIC language and have written some simple programs. These introductions to BASIC help people gain a better understanding of computers and the nature of programming. However, they are not sufficient for learning to write the types of programs most people want to use. It's a lot like learning a foreign language: learning some of the vocabulary and grammar in school or from a book does not make you a fluent speaker of the language.

Humanized Programs

In this month's column, let's examine two books designed to help you become fluent in BASIC. Both books are for people who already know the fundamentals and want to learn more, and both teach you to develop well-structured, easy-to-use programs. These books are designed to be read while you work at the computer – the only way to learn a language, whether a human language or a computer language, is to practice using it.

Apple Backpack: Humanized Programming in BASIC, by Scot Kamins and Mitchell Waite. Byte Books, 1982, $14.95.

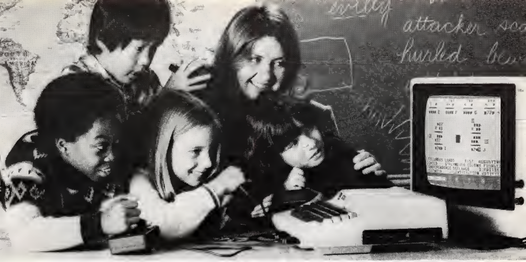
This book aims to help you learn to write *humanized* programs – the authors' term for what others call "user-friendly programs." Humanized or user-friendly programs make the computer adapt to the people who use it, rather than force the people to adapt to the computer. Humanized programs provide easy-to-understand screen displays and clear instructions. They give prompts when users are to enter responses and let users correct or change responses. They wait until users signal they are ready to proceed, and provide help if users become confused or forget some of the instructions.

After a brief introduction about humanized programming, *Apple Backpack* contains four chapters which explain many of the techniques for creating well-designed programs. Each chapter starts with simple components of programs and gradually builds more complex and powerful routines. Although the examples are written in Applesoft BASIC, they are all easily modified for other versions of BASIC, and the authors are careful to point out when they use commands that are idiosyncratic to Applesoft. Therefore, this book will also be useful to those who are using Commodore, TRS-80, Atari, and other computers.

Chapter 1 shows how to create well-formatted screen displays. It begins with algorithms for centering and right justifying text and for drawing borders. It then proceeds to more sophisticated routines. These include an "anti-splitting" routine for formatting text so that words are not split between lines, a routine which presents long sections of text, one screen-full at a time, and routines for formatting numbers into columns.

Chapter 2 is about "crashproofing" programs – designing them so that they behave reasonably when users give unexpected responses. This chapter shows how to create programs which check for incorrect input – a number when a letter is expected or vice versa, too large or small a number, a name with too many letters, a response that begins with a space, or one of the many other possibilities that can wreak havoc on programs that are not crashproofed.

Chapter 3 shows how to write programs which let users check and change information they have entered. It covers programming to allow users to make immediate corrections and to make



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changes after all the information has been entered and processed.

Chapter 4 covers providing directions and helpful information on the computer screen. It describes the need for clear instructions within the program and the value of providing prompts when people are to enter information. It also covers techniques for making extra help available when the user presses a special key.

These four chapters on programming provide an excellent blend of general discussion, examples of programming routines and complete modules, and very clear, line-by-line explanations of how each program works. While you can simply plug the provided modules into your own programs, the authors' main aim is to help you understand the modules presented and learn to create your own.

There is a fifth chapter which is not about programming at all, but about principles of writing good documentation. This chapter discusses both tutorials which help beginners get started and reference aids which serve as reminders for those who have learned to use the program.

The appendix contains two complete programs, a States and Capitals educational game and an Electronic Phone pad for storing and retrieving telephone messages. These programs demonstrate how the modules discussed in Chapters 1 through 4 can be combined into useful, humanized programs. Each program has complete written instructions which demonstrate the principles in Chapter 5.

Apple Backpack is a valuable guide for anyone who has mastered the fundamentals of BASIC and wants to become a fluent user of the language. It is at the right level for those who have been introduced to the BASIC commands and written a short program or two. Careful study of this book will help novice programmers advance a long way toward creating their own sophisticated, humanized programs.

Graphics And Sound

Techniques for Creating Golden Delicious Games for the Apple Computer, by Howard M. Franklin, Joanne Koltnow, and Leroy Finkel. John Wiley & Sons, Inc., 1982, $12.95.

This book focuses on programming the graphics and sounds that are such an important part of computer games. Its philosophy is similar to *Apple Backpack* in that it explores principles of good program design and coding, example program modules, and actual programs. However, the sound and graphics programming examples are unique to Applesoft BASIC, so this book is only for those who are programming Apple computers.

Entering many of the programming examples requires a great deal of typing and, of course, everything has to be exactly correct. Fortunately, a set of two disks containing all the routines is available from the publisher for $34.95.

The first of the seven chapters covers musical notes and sounds. It begins with simple routines which use the "bell" sound built into the Apple. On the Apple, more sophisticated sounds require a machine language routine. The authors provide a suitable one to be used as a musical "black box" – you are told how to use it, but not how it works. Since the book is about BASIC, but a machine language routine is required to play musical notes on the Apple, this is a good approach.

Several interesting programs make use of the black box. One plays simple tunes, another turns the Apple into a toy piano in which each key plays a different note, and a third lets you experiment with different sound effects. The sound effect program can be valuable for developing sounds to fit your games.

Chapter 2 introduces the fundamental commands for using low resolution color graphics. Chapter 3 offers an image module which lets you display low resolution images on the screen in any position and color. It also provides a set of uppercase letters and numbers created with low resolution graphics. In addition, this chapter explains how to design new images and incorporate them into the program, and it gives several example pictures.

Chapter 4 is on high resolution graphics. More on this chapter later.

Chapter 5 covers routines for handling data entry. A sophisticated, general-purpose input module is presented. By using this input subroutine within your program and setting certain variables, you can control whether the computer will accept letters (and the maximum length of the response), integer or decimal numbers (even setting the lowest and highest acceptable values), Y or N only (for yes/no questions), or any single keypress.

The input subroutine also signals when the ESC key is pressed, so you can use ESC within your programs to let the user ask for help, return to an earlier part, quit, or request other special functions. This input module is powerful and can greatly simplify writing programs requiring different types of responses from the user. It will also help you crashproof your programs.

Chapters 6 and 7 include fully developed games which use the modules from Chapters 1, 2, 3, and 5. The programs include: (1) a story game in which the computer asks a series of questions and then inserts the answers in a previously constructed story format; (2) a nonviolent version of the hangman word game; (3) a word-matching game; (4) a concentration game which uses

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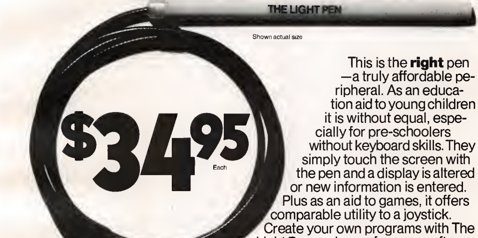

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matching color patterns; (5) a number-guessing game; and (6) a version of the memory game Simon. While none of these games will put *Pac-Man* out of business, they are all good examples of the types of educational games many people could learn to program, and they provide useful examples of how to incorporate the modules into programs.

Routine Libraries

The sound, low resolution graphics, and input modules in this book are valuable components which can simplify creating many programs. These modules, and the discussion in the book, encourage people to develop their own libraries of general-purpose subroutines and to develop well-structured programs. In addition, a great deal can be learned by studying how the games are programmed and making your own revisions and extensions of them.

Since *Golden Delicious Games* focuses on sound and graphics while *Apple Backpack* focuses on text and number processing, the two books complement each other very well. In fact, the only way they overlap significantly is that both provide routines for accepting input. A comparison of the similarities and differences of the two input routines is interesting in itself, since it lets you compare different approaches to the same goal of making it easy for people to enter information.

However, the *Golden Delicious Games* book contains very little discussion of how each module works. Also, there isn't an adequate discussion of high resolution graphics. The chapter on high resolution graphics is by far the shortest one in the book, and about one-third of it is spent discussing the problem of color conflicts on the Apple screen. Unfortunately, the simple solutions to this problem are never mentioned. We can conclude this month's column with an overview of hi-res graphics.

Software For High Resolution Graphics

There are three general types of software tools for using high resolution graphics from Applesoft BASIC. One type is high resolution character generators, which let you create your own character sets and display them on the high resolution screen. Such sets are useful for combining text and pictures, for using characters of different sizes and colors, for having non-English alphabets in your programs, and for adding lowercase letters to the Apple II and II+ screens. High resolution character generators are designed so that the standard BASIC print command is used to display characters from your program. You can also create characters of different shapes and combine them on the screen to form pictures. By printing, erasing, and reprinting these characters, you can even create simple animations.

The second type of high resolution tool lets you create pictures that cover all or part of the screen, save them on a disk, and bring them back to the screen from your program. Some of these tools use commands typed on the keyboard, some use joysticks or game paddles, and some use graphics tablets. In the November 1982 "Learning With Computers" column I reviewed picture-creating programs. My focus there was computer art, but the pictures created with those tools could be easily incorporated into programs.

The third type of high resolution tool facilitates working with shape tables. Shape tables save instructions to the computer for re-creating a shape you have drawn. Commands in BASIC let you place the shape anywhere on the screen, as well as change its size, orientation, and color. Shape table pictures can be placed over a full screen picture and can be used to create animations.

The following is a list of companies which market programs to help you incorporate sophisticated high resolution graphics into your programs. This list doesn't cover all those available, but I have used all the programs listed below, and each serves its intended purpose well. With these tools, you can program professional quality high-resolution graphics. In fact, the *High Text* and *Graphics Magician* programs listed below are widely used in commercial educational programs:

1. Synergistic Software (5221 12th Ave. S.E., Bellevue, WA 98006) offers *High Text*, an advanced high resolution character generator which lets you use characters of different sizes and colors. It also produces a good tool, called Higher Graphics, for working with shape tables.

2. Penguin Software (830 4th Ave., Geneva, IL 60134) sells the well named *Graphics Magician*. It combines picture creating, shape table, and animation capabilities.

3. Beagle Brothers (4315 Sierra Vista, San Diego, CA 92103) has several high resolution character generator, picture-creating, and shape table programs.

4. Edu-Soft (P.O. Box 2560, Berkeley, CA 94702) markets an inexpensive high resolution character generator program. ©

Develop-20

Tina Halcomb

Without a knowledge of assembly language, it can be an impossible task to turn a great idea into a fast, smooth game. One solution to the problem is *Develop-20*, a collection of software tools designed to help the VIC-20 programmer advance beyond BASIC.

Develop-20 consists of an Editor, Assembler, Loader, Monitor, and Decoder. A similar collection, *Develop-64*, is available for the Commodore 64.

An informative guide is included with the package. If you are not already acquainted with 6502 assembly language, you will find this guide a very good introduction. It describes the architecture and functions of the 6502 chip from a user's viewpoint. The definitions and examples clearly explain the use of the addressing modes, register set, and instruction set.

The Editor

The original (Source) programs are created and modified with the Editor program. As you enter your program, it checks the validity of the mnemonics, and checks to see if the correct addressing modes are being used with respect to the mnemonics.

When you run the Editor, you will see a CPLDIMS prompt. You can then choose one of the seven functions of the Editor program. C is the create mode, used to enter new programs. P prints a listing of the program to the screen. L loads a program on cassette or disk into memory. S saves the source file in memory to cassette or disk. The editing capabilities of the Editor program are limited to D, which deletes lines; I, which inserts lines; and M, which lets you modify any line. Modifications can be made only one line at a time.

There are two unusual aspects to this Editor. When you use zero-page addressing, you must identify the address with a left arrow.

```
STA ← $00
```

Most assemblers are capable of determining that you intend zero-page addressing if the specified address is in zero page ($00-$FF).

Also, during program entry, there is no space allowed between the opcode field and the operand field. However, once each line of the program is entered and you press RETURN, the line is displayed in the standard 6502 assembly format with one space between each field.

In an unexpanded VIC, you can write programs with up to 89 statements. With any size memory expansion, the program size can increase by 50-75 statements per K of memory.

Assembling The Program

To translate your source program into executable machine (object) language, it must be loaded in with the Assembler program, assembled, and saved as an object file. The actual *saving* process is identical to that of the Editor program. You must remember that the two output files are different. The source is saved like any other text file, and the object is saved as a binary file. A distinguishing extension for the file name is not automatic. Perhaps setting a standard of extensions like a .BIN or .OBJ for binary object files and .TXT of .SRC for the text source files will make it easier for you to identify them.

Due to the limited amount of memory, the programs are assembled to a file on disk or cassette instead of directly into memory. In order to run the object code that you have just created with the Assembler program, you must save the object file and load it back into memory with the Loader program.

RUN In Single Steps

The Monitor is a very useful tool for debugging your software. It allows you to load your program and run it in single steps (one instruction at a time). As each instruction is executed, the instruction is displayed along with the status of all registers. This allows those just learning the language to watch what happens in each register and what changes occur in the status register (the flags) as a program runs.

The fifth tool of this package is the Decoder, which is a disassembler. This program takes machine language (executable object files) and translates them back into source files (mnemonics). The program produced by the Decoder will only resemble the original source program because it does not produce labels. For example, in a loop, instead of seeing branches to labels, you will see jumps to absolute addresses.

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graphics tools? The manual includes information concerning screen and character management, color modes, joystick controllers, and sound and musical effects.

This collection of software tools is an effective, reasonably priced way to develop your machine language ideas into working VIC programs.

Develop-20
French Silk Smoothware
P.O. Box 207
Cannon Falls, MN 55009
$49.95 ©

Astro Chase

John Blackford,
Assistant Features Editor

Astro Chase, by Fernando Herrera, is a lively space-action game with impressive graphics and sound. Written for Atari, it contains several innovative features that distinguish it from others on the market.

The object of the game is to defend Earth from aliens of the Megard Empire. The playfield, which is a two-dimensional (map-style) depiction of the galaxy, is several times larger than the area visible on the screen. As you move your ship – Earth's sole defender – toward the edges of the screen, the background scrolls to reveal other portions of the galaxy. You can't visit the entire galaxy, however. The Megardians have thrown up an invisible force field that keeps you in the vicinity of Earth.

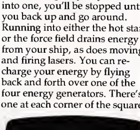
That's just as well, for to succeed at *Astro Chase*, it's best to cruise near Earth, intercepting the robot-like Mega Mines as they move in. If one of the mines reaches the home planet, the result is a spectacular, game-ending explosion.

The Mega Mines have only one objective: to reach Earth. They never deviate from their path and cannot attack your ship, but the attack fighters can and will. As you advance to the higher levels, the fighters become more numerous and wield more impressive power. Some of them try to ram your ship; others fire lasers; some can even pass through planets in their relentless search for your craft. If you spend too much time going after the fighters, the Mega Mines will surely get through.

Maneuvering Hints

One of the most challenging aspects of the game is learning to control your spaceship. You can set your course, then aim and fire your lasers independently – all with the joystick and fire button. The result is a very versatile craft, but one that's difficult for beginners to handle. The secret is that when the fire button is depressed, the joystick controls the direction of the lasers. When the fire button is up, the joystick controls the ship. It sounds simple, but practice is required.

If you bump into a planet or the force field, you'll bounce back – perhaps adding to the confusion until you get the hang of maneuvering the ship. Another pitfall is the *hot stars*. These are bright stars scattered around the galaxy. If you run into one, you'll be stopped until you back up and go around. Running into either the hot stars or the force field drains energy from your ship, as does moving and firing lasers. You can recharge your energy by flying back and forth over one of the four energy generators. There's one at each corner of the square



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force field.

Shield depots are also located around the force field perimeter. When you fly through one, your ship turns from solid white to flashing colors – and you are invulnerable for ten seconds. You can even ram and destroy the attack fighters. But don't neglect your main mission: eliminating the Mega Mines.

For Experts Only

When you begin *Astro Chase*, you are in level eight. With the Select button, you can choose any one of 24 levels. Each time Earth is destroyed, you move down one level. But if you destroy all 16 Mega Mines, you move up to the next higher level. And if you go beyond level 24, you reach the master level (24-34); it's definitely for experts only.

The graphics in the game opening and the intermissions after each group of seven levels strikingly depict the spaceport on Earth. In the first sequence, you, the pilot, walk out and beam onto the spacecraft, which lifts off in a blaze of rocket fire.

The pilot returns to the spaceport in the first intermission, looks around, and asks, "Where is everybody?" Each scene that follows is slightly different. If you move from the lowest levels all the way to the expert grade, the intermissions provide a little story line within the game.

The action in *Astro Chase* can get pretty frantic as you dodge the fighters, bouncing into planets and stars – all the while trying to stop the undeviating Mega Mines. But you can succeed by mastering your ship's movement and developing a prudent strategy for engaging the Mega Mines. If you like space-action games, this is one to look for.

Astro Chase
Parker Brothers
50 Dunham Road
Beverly, MA 01915
(617)927-7600

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Galactic Blitz For The VIC-20

Tony Roberts, Assistant Managing Editor

You're sitting alone in your spaceship when, suddenly, swarms of aliens, daring you to shoot them down, appear in the darkened sky. The aliens swirl, dart, and loop-the-loop before streaming off out of sight. Seconds later they return to taunt you again.

The game is *Galactic Blitz*, produced by Tronix for the unexpanded VIC-20. The instructions are simple: shoot down the aliens, pile up the points.

Galactic Blitz, programmed by Jimmy Huey, is a smooth, fast machine language game that looks deceptively easy. But it turns out to be devilishly frustrating and mildly addicting. Throw in the eerie whine of the aliens and the game takes on a hypnotic quality.

With a joystick, you move your ship back and forth along the bottom of the screen. You fire in only one direction – straight up.

The aliens, which attack in groups of 15, could easily find work in the National Football League. They run patterns more precisely than any wide receiver. They swirl, climb, and dive one after the other until all 15 have either been shot down or have completed their pattern.

But even as the colorful alien squadron dazzles you with its precision flying, its members are on the attack. They drop a barrage of bombs that keep your ship on the move.

Be Prepared To Dodge

The 15 patterns the aliens employ are easy enough to learn, but discovering the best defense against each is more difficult.

If you find yourself cowering in the corners to avoid the bombs raining down at center screen, you may lull yourself into thinking you've found the answer. Check the score counter, and you'll find many of the aliens are blinking off the screen before your hits are recorded.

As the game progresses, the aliens move lower and lower, giving you less time to react to their bombs. In one pattern the crafty attackers fly off the bottom of the screen, then reappear right where you're likely to have positioned your ship. Just when you thought you were in control, you've lost another vessel.

Galactic Blitz is easy to play, but not easy to beat. And you'll find yourself trying to win again and again.

Galactic Blitz
Tronix Publishing, Inc.
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Space Station I For The TI

Tony Roberts, Assistant Managing Editor

Space Station I mixes the sprite movement and sound abilities of the TI-99/4A with an interesting space-attack scenario to produce a fluid and challenging arcade-quality game.

The program, available on disk or cassette from Data Force, requires that your TI be equipped with Extended BASIC and extra memory.

The action takes place in the year 2020. An invisible alien force has attacked and defeated a secret military outpost orbiting Saturn, and has turned its attention to Earth, which you must defend. The battle at Saturn, however, took its toll on the alien force, weakening its firepower, damaging its tactical computers, and making its drones visible 99 percent of the time.

Once the battle began, the Saturn outpost lasted only 34 seconds, but during that time, the station's tactical defense computer was able to transmit information back to Earth. The computer's report, which is printed in the instruction pamphlet, includes clues for developing the strategy you'll need to stave off the attackers.

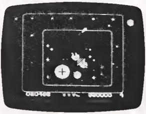
Watch Battle On Scanner

On your scanner screen, you see Space Station I, orbiting quietly. Two green boxes are drawn around it. Press ENTER, and the sprite display begins. The alien drones, attacking in groups of three, swoop in; misguided missiles and bombs fly past; an orange alien command ship may appear from out of nowhere.

Using the keyboard or a joystick, you bring your target beam into play. Place it over an alien ship or missile and fire a torpedo. The torpedo, which is released from the bottom of the screen, flies to the point designated by the target beam and detonates. The beam can be moved to a new target before the first torpedo detonates.

Most of the alien missiles are harmless. Those released by the drone ships or the command ship, however, are not. Your main concern is stopping the drones. They attack in groups of three, and sometimes hide off the edges of the screen. You'll learn to listen for the characteristic sound that tells you the drones are nearby.

The drones will fire only from within the inner green boundary, and once a missile is



The green targeting beam is used to zero in on the aliens in Space Station I.

fired, the drones are helpless until the missile hits Space Station I or flies past the boundary area. If a missile is off course, it is best to attack the drones while they are helpless, then drop back on defense. Your station can survive five hits before the game ends.

The Command Ship

Your other concern, the command ship, has neither lost its invisibility nor its long-range firing ability. It must become visible to launch an attack, but after it fires, it disappears again. The command ship's foghorn-like sound, however, is its weakness. When you hear it coming, search for it with your targeting beam (you'll see its shadow if you find it), and fire.

Space Station I starts out rather slowly, giving you a chance to find your way around. But with each 10,000 points you accumulate, the aliens step up the attack. If you manage to accumulate 100,000 points, your hit counter will be reset to one, giving you four chances to play at high speed.

To play the game successfully, you'll have to develop a sound strategy, and you'll have to be capable of reacting to assaults from all parts of the screen. It's quite a challenge.

Space Station I
Data Force Incorporated
10 S. 312 Hampshire Lane East
Hinsdale, IL 60521
(312)323-0179
$34.95

©

Calc Result

August Schau

"Spreadsheet" programs have proven to be among the most popular software for microcomputers over the past several years. Essentially, a spreadsheet is a specialized language – complete with rules and commands – designed to help with simulations and modeling. They let you set up complex arrays of interrelated information and then, by changing one aspect of the model, you can watch the effects throughout the entire structure. Spreadsheets are especially useful in analyzing budgets, finance, and other systems which are based upon mathematical relationships.

Calc Result is a spreadsheet program for the Commodore 64. It organizes information on a grid made up of 63 columns labeled A-BK, by 254 rows. Individual cells within the grid are identified by referring to the column and row that intersect at

the cell location. For example, the cell located at the intersection of column M and row 19 has coordinates M19. One 63 by 254 matrix of cells is called a page, and a *Calc Result* file can contain up to 32 pages.

Calc Result will store data in these cells as labels or values. Labels are descriptive text, and values are numbers that can be entered directly or calculated according to a formula that is stored in the cell. The program assumes that a value or formula is being input, and unless told otherwise it will not allow a label to be entered as a value. By referring to the coordinates of other cells, the program can incorporate their present values into a formula. Formulas operate according to normal mathematical laws and may include trigonometric functions.

When the value in a cell is changed, the values in all cells containing formulas that refer to the changed value are automatically recalculated. All formulas are protected so that a value cannot be entered and replace the formula in the cell. If this occurred, future recalculations would be affected. This protection can be removed so that formulas can be edited.

Special Functions

Formulas including special functions such as MEAN can be used instead of the lengthy formula that would otherwise be necessary to find the average of the values from a large number of cells. Other functions can search through a specified group of cells and locate the largest or smallest value within these cells.

The IF-THEN...ELSE function allows a formula to take one of two forms depending on whether a predefined condition has been met. For example, the formula can test the value in a cell, multiply the value by 3 percent if the number falls below $250 or multiply by 6 percent if the value is $250 or greater.

The three-part manual, bound in a 7-by-9-inch ring binder, uses color-coded pages for easy identification. Part one contains instructions for the initial start-up and preparation of program and data disks. The master disk prompts the user through the creation of a program disk. In the process, information is entered about the printer and number of disk drives.

English is selected for the help screens from the eight languages available, and colors are selected for the border, background, and foreground. The newly created program disk is used to create a data disk for use with dual disk drive setups.

Part two is a five-lesson tutorial that introduces the user to *Calc Result*. The instructions are keystroke by keystroke at the beginning, but in subsequent lessons, the instructions become less specific. During a lesson you can check your progress against the numerous color illustrations. The values in key cells are also given as a self-check.

Part three is a reference containing descriptions of all of *Calc Result*'s commands and functions. In my copy of the manual, I have inserted a divider at the beginning of this section for quick access to the reference index.

Help Always At Hand

Calc Result contains a series of help screens to replace the pocket reference cards that often come with software packages. When the system commands are accessed with the F7 key, you are prompted across the top of the screen with the symbols of the available commands. If you do not recall what each symbol stands for, the F5 key will display a list of the symbols and the commands they represent along with a brief explanation of the command.

The desired symbol can be entered directly from the help screen.

The help screens, which operate quickly and efficiently with only a momentary interruption in the operation of the program, eliminate the need for repeated use of the reference manual.

Duplicating Pages

Once labels and formulas have been entered on a page, the page can be used to create additional pages with the identical format. Labels and formulas will be transferred to the new pages. The newly created pages can be called to the screen and titled so they are easier to tell apart.

The values from each cell of an individual page can be added to the values in the corresponding cells of other pages. These sums are placed in corresponding cells on page 32. When pages are added in this fashion, the cells on page 32 will have formulas identical to the individual pages, and the summary page will have the same recalculation power. Pages also can be added so that the values of the corresponding cells are added without carrying the formulas to the summary page.

The addition function would support the design of an annual budget that accepts monthly data and provides an end-of-year summary.

When *Calc Result* files are called up from the data disk, all of the pages are temporarily stored in a work area on the program disk. With a single disk drive, files must be saved on the program disk since data stored in files can be brought into internal memory only via the work area.

Two pages at a time can be loaded into the computer's internal memory, where data is entered onto the page and calculations made. Either of the pages currently stored in internal memory can be worked on by calling it to the screen. If a third page is called up, the page currently

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RAM/ROM — 4K	$75
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Battery Backup Option	20

SUBSORT for PET/CBM — $35
Excellent general purpose machine language sort routine.

THE WHOLE PET CATALOG — $9
A two year 320 page compendium of the Midnite Software Gazette for Commodore computer users. Contains 500 reviews of commercial products, 700 education programs (reviewed and organized by course), 200 reviews of free games, info on over 1800 free programs, list of PET and VIC user groups, and many pages of helps and hints

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SuperGraphics 2.0
NEW Version with TURTLE GRAPHICS
SuperGraphics, by John Fluharty, provides a 4K machine language extension which adds 35 full featured commands to Commodore BASIC to allow fast and easy plotting and manipulation of graphics on the PET/CBM video display, as well as SOUND Commands. Animations which previously were too slow or impossible without machine language subroutines now can be programmed directly in BASIC. Move blocks (or rocketships, etc.) or entire areas of the screen with a single, easy to use BASIC command. Scroll any portion of the screen up, down, left or right. Turn on or off any of the 4000 (8000 on 8032) screen pixels with a single BASIC command. In high resolution mode, draw vertical, horizontal, and diagonal lines. Draw a box, fill a box, and move it around on the screen with easy to use BASIC commands. Plot curves using either rectangular or polar co-ordinates (great for Algebra, Geometry and Trig classes.)
The SOUND commands allow you to initiate a note or series of notes (or even several songs) from BASIC and then play them in the background mode without interfering with your BASIC program. This allows your program to run at full speed with simultaneous graphics and music.
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for PET/CBM Computers
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Record size limit is 256 characters. The number of records per disk is limited only by record size and free space on the disk. File maintenance lets you step forward or backward through a file, add, delete or change a record, go to a numbered record, or find a record by specified field (or partial field). Field lengths may vary to allow maximum information packing. Both subtotals and sorting may be nested up to 5 fields deep. Any field may be specified as a key. Sequential file input and output, as well as file output in WordPro and PaperMate format is supported. Record size, fields per record, and order of fields may be changed easily.

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Flexible printing format including field placement, decimal justification and rounding. Define any column as a series of math or trig functions performed on other columns, and pass results such as running total from row to row. Totals, nested subtotals, and averages supported. Complete record selection, including field within range, pattern match, and logical functions can be specified.

FLEX-FILE 2 by Michael Riley — $110
Please specify equipment configuration when ordering.

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Branding Iron EPROM Programmer for PET/CBM software for all ROM versions. Includes all hardware and software to program or copy 2716 and 2532 EPROMs

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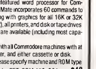

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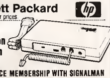

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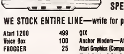

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displayed on the screen is moved to the work area to make room.

Impressive Split-Screen And Plotting Capability

Splitting the screen horizontally or vertically allows you to view two pages. The cursor can cross the boundary between pages to operate on the individual pages. To view additional pages, a window can be created in one of the sections. The area to remain outside of the window must be formatted and scrolled to the desired position before the window is created because the cursor cannot leave the bounds of the window. The screen area inside the window can then be split, and a third and fourth page can be called into the window area.

A graphics function prepares a histogram of the values from any column or row. The procedure is simple and the results are impressive. Place the cursor in the row or column desired and select the graphics function. Enter column or row depending on the graph desired, enter the lower and upper limits of the scale to be used on the chart, and type in a title.

A full-screen chart containing eight bars is created with a labeled scale along the left margin. The chart can be scrolled left and right with the cursor keys to display the bars for the entire column or row.

The portion of the chart displayed on the screen can be printed.

I have used another spreadsheet program with a Commodore 8032 to introduce this type of computing to my data processing students. *Calc Result* compares quite favorably with the other program and includes additional features such as color, graphics, and multiple pages. I highly recommend it.

Calc Result
Computer Marketing Services, Inc.
300 W. Marlton Pike
Cherry Hill, NJ 08002
$149.95

©

Atari *Airstrike*

James V Trunzo

The creators of *Airstrike* warn you in their advertisements that *Airstrike* is "very, very difficult" and that it is "The definitive, super-fast, multiple-skill, shoot-out game for Atari 400/800...." This warning is the last mercy the game designers do for you. *Airstrike* turns you into the "Rocky" of game players; it keeps knocking you down and you keep coming back for more.

At first glance, *Airstrike* appears to be little more than a typical see 'em and shoot 'em arcade-style game. Like *Scrambler* and *Cosmic Avenger*, *Airstrike* puts the player in the cockpit of a fighter bomber and sends him careening across the screen, firing at anything that moves. Surface to air missiles must be destroyed before they destroy you. Like *Caverns of Mars* turned on its side, *Airstrike* forces you to navigate through a field of fission bombs that move randomly up and down the display screen. Unlike other games, however, *Airstrike* takes these ideas one step further, moving them from the realm of the difficult to the almost impossible. And *Airstrike* throws in more than a few original ideas and variations of its own.

Quark Bombs

When play begins, the player is given three Mark V fighter bombers capable of one-way flight (though it can be jockeyed up and down) and armed with both a laser cannon and quark bombs. The cannon is front-mounted and is controlled by the fire button on the joystick, the shot traveling horizontally; the bombs, controlled by the space bar, arch out of the vessel, dropping on targets below.

Several things should be mentioned concerning the weapons. Unlike other games, pressing the fire button does not fire the cannon while simultaneously releasing a bomb. What this means is that the player who typically keeps both hands on the joystick must adjust to the necessity of freeing one hand to drop bombs. Also, because the bombs arch away from the ship, timing becomes a bit more precise. And it is crucial that the space bar be completely depressed or the bomb will not be released, and the amount of ammunition you have is limited.

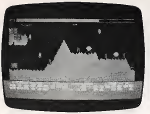
On the easiest of the five levels, you begin with 10 quark bombs and 40 shots in the laser cannon. You cannot simply fire shot after shot and release bomb after bomb. Accuracy becomes essential to completing a mission and achieving a good score. Actually, the destruction of most ships will be the direct result of having missed a shot. This is due, for the most part, to the fact that successful play occurs after the player has established a pattern of sorts and fallen into a rhythm. Missing a crucial shot upsets the pattern and disrupts that rhythm, and then another Mark V goes up in a nicely done graphic explosion.

Incidentally, though you begin the mission with a limited amount of fire power, you can gain extra missiles and bombs by destroying ammo dumps. (Don't miss the last ammo dump before entering the meteor shower; that's almost certain doom.)

Several Screens

To complete one full mission, you must traverse a number of screens. The first two screens are made up of basic mountain-type terrain. These ranges are defended by surface to air missiles and fission bombs, the latter of which are really nasty because of their erratic movement.

Once you're past the mountain ranges, the next display forces you to navigate across an entire screen of descending



Airstrike.

meteors whose slightest touch spells instant extinction. The meteor shower looks suspiciously like a lot of fission bombs raining down upon your ship, but in any case, this screen is no easier than the first two.

Assuming you pass safely through the meteors, you approach a series of sliding airlocks which must be blown open (achieved by hitting an area about the size of a pinhead – while it's moving) in order to complete your first pass. And did I mention that all the airlocks after the first are guarded by alien ships that must be circumvented in order to survive? Or that the locks are in various positions on the screen and not a straight shot so joystick maneuvering is a must? Very, very difficult, and this is level one.

If there's anything after this, I wouldn't know because I've never made it through a complete pass. The instructions indicate that once through the sliding airlocks, the player proceeds to the next color-coded level at which point, I assume, the mission repeats itself. The added difficulty, from what information could be gleaned by selecting a higher complexity level to begin with, stems from the fact that the enemy defenses move much faster and the player's vessel begins its run with less ammunition.

Airstrike comes with several options. For openers, there are five difficulty levels at which to begin play. In addition, the game can be played by either one or two players, alternating turns. Also, a game may be interrupted during the course of play by depressing the CTRL key and 1 together.

A minor annoyance occurs after you lose one of your three ships: the next one appears so fast that there is little time to regroup. The only other complaint that might be registered is that until you are within the sliding locks area, any destruction of your ship sends you back to the very beginning of the program. Because it's so difficult to advance from screen to screen, especially for novices, this can be a tad frustrating.

All in all, *Airstrike* is exactly what it claims to be – a very demanding program. If you want a challenge, *Airstrike* is the game for you.

Mechanically, the game is quite strong. The scrolling and the graphics are very well done. The player's ship, missiles, bombs, and targets are clearly defined and, with the exception of the spaceship itself, all graphics are flicker-free. In addition, colors are vivid and the sound effects, though limited to explosions of one type or another, are more than adequate.

Airstrike
English Software Company
P.O. Box 3185
Redondo Beach, CA 90277
$39.95

©

HESCAT For PET/CBM

Steve Leth

Soon after getting my PET, I realized I had a problem: cassettes. Hundreds of them. All over the place. After buying a disk drive, I thought my troubles were over. But now I have a new problem: diskettes. Hundreds of them, and, worse yet, they each hold one to two dozen programs. What I needed was a way of cataloging all these programs and the disks they're on: an inventory program, for programs. Enter *HESCAT*, a disk catalog program written by Jerry Bailey and distributed by Human Engineered Software.

HESCAT is available on disk for versions of PET/CBM with Upgrade ROMs or 4.0 BASIC, 40- or 80-column screens, and at least 16K of memory (32K preferred). It works with 2040, 4040, and 8050 disk drives.

How *HESCAT* Works

HESCAT is a series of programs accessed via a menu that appears when you run the main program. To perform a particular function, you just enter its number and the appropriate program is loaded. After each function is complete, you return to the main menu. Because every function except HELP is implemented as a separate program, *HESCAT* packs a lot of power into a 16K PET/CBM.

The first step in using *HESCAT* is to catalog your diskettes with the CATALOG function. CATALOG copies information from the directory of the disk being cataloged, which is in drive #1, and records it on the *HESCAT* disk, which must always be left in drive #0. After it has retrieved all the data from one disk, *HESCAT* asks you to insert the next disk. This continues until information from all your disks has been recorded on the *HESCAT* disk.

Exactly what kind of information is kept for each disk? The two-digit disk ID, the disk name, the number of free and allocated sectors, and the number of files on the disk are stored in a file called HEADERS. Then, for each diskette, *HESCAT* creates a file with the same name as the two-digit disk ID. This file contains a list of all the files on that disk, the type of file (Sequential, Program, Relative, or User), and the size of each file. On a 2040 or 4040 disk, you can catalog as many as 120 disks with 3300 to 6000 files; an 8050 disk will keep

track of 10,000 to 20,000 files from 210 disks.

After cataloging new disks or recataloging an old disk that has been changed, the SORT NAMES function is used to create the ALPHA.NAMES file. This is a list of all your cataloged files, sorted alphabetically. It also contains the type of each file and the ID of the disk it's on. The sort routine itself is a heapsort and is written in machine language. All the names that will fit into memory can be sorted in a second or so. Usually, however, the list of names is too long to fit in memory. In this case, *HESCAT* uses a scratch disk for work files that are sorted individually and then merged together. It will only sort file names from disks that have been recataloged since the last sort and will merge them into the new ALPHA.NAMES file.

Once the names have been sorted, a number of reports can be generated using the PRINT function. You can request a listing of file names, showing the file type and what disk it's on; a listing of the directories of the individual disks; or a summary of the disk header information. All of these will list on a CBM or other printer. The program also contains a subroutine for Epson and Base 2 printers.

Another practical use for *HESCAT* becomes apparent when you use the LOCATE function. This function searches through the file names cataloged by *HESCAT* for a string specified by the user and displays all the names that contain that string along with their disk ID's.

This is really a most valuable function when you forget where you stored your *Space Invaders* game.

Complete Documentation

HESCAT comes with two manuals totaling 37 pages. The first is the *User Manual* that guides you step by step through the process of cataloging disks and getting reports. The manual is clearly written and points up a number of spots where things might go wrong (especially disk I/O errors) and how to recover without losing your data. The second is the *Program Manual*, which covers technical information about the actual *HESCAT* programs. Included are detailed line-by-line narratives and variable dictionaries for each program. There is a section on how to safely modify parts of *HESCAT* and a complete description of all of *HESCAT*'s file formats. In addition, the *Program Manual* includes complete, commented listings of all the programs, even an assembly listing of the heapsort routine. Because Jerry Bailey has used a lot of "tricks" to make *HESCAT* fast and compact, you can learn a lot by reading the *Program Manual*.

It is apparent that much thought went into making *HESCAT* as easy to use as possible. All user interaction with the programs is via menus, and *HESCAT* seems reasonably crash-proof. One of my favorite features is the HELP function in the main menu program. HELP displays a brief description of each of *HESCAT*'s major functions. The information provided by HELP was often enough to keep me from having to refer to the manual.

To use *HESCAT* properly, you must update the catalog every time you start a new disk or add files to an old disk. If you don't do this, then *HESCAT* won't do you much good. However, if you are the sort of person who will keep the catalog updated, and you want an automated tool to help you, *HESCAT* is the program for you.

HESCAT
Human Engineered Software
71 Park Lane
Brisbane, CA 94005
$39.95

©

Book Review
TRS-80 Color Computer BASIC

Tony Roberts, Assistant Managing Editor

If you have a Color Computer and are taking your first steps in BASIC, Richard Haskell's book, *TRS-80 Extended Color BASIC*, can help make sure your feet are firmly planted.

Like its companions for the Apple, Atari, and PET computers, this book is designed as a textbook. It starts out assuming the reader knows nothing about the TRS-80 Color Computer (or BASIC) and builds from there.

Although the title implies that the contents refer only to Extended Color BASIC, the book serves equally well as a Color BASIC tutorial. Only a few, short references are made to commands or functions not available in Color BASIC.

Though written to be used with a computer at hand, *TRS-80 Extended Color BASIC* can be a useful study guide when no computer is available. The 170-page book is packed with screen photos that show what happens when the sample programs are run. The photos also show what happens when common programming or input errors are made. The text carefully explains why the mistakes happened and shows the novice programmer how to avoid the problem in the future.

Start With The Basics

Once you have been introduced to the TRS-80 Color Computer and have learned to print your name on the screen, *TRS-80 Extended Color BASIC* takes on the BASIC statements one by one.

Many of the example programs in the book's early chapters have a mathematical bent. You learn to compute the area of

various geometric shapes, and you are treated to an explanation of the trigonometric functions. Some of these may be lost on the beginner who is more concerned with learning about the computer than recalling high school math.

Once those problems are out of the way, however, Haskell clearly explains the things beginners need to know to get started in programming – printing to the screen, loops, and the IF...THEN, ELSE statements. Further along the way, simple and high-resolution graphics, sound, arrays, and the PEEK and POKE statements are covered.

The final chapter, called "Putting It All Together," leads you step-by-step through the programming necessary to create a hangman game and to turn your computer into a color organ.

No Machine Language

Though the book makes no attempt to teach any machine language, one of the nine appendices discusses, in a few short paragraphs, how to use a machine language subroutine in a BASIC program. Other appendices include information on BASIC's reserved words, ASCII codes, error messages, hexadecimal numbers, the EDIT statement, the PRINT USING statement, and screen locations.

TRS-80 Extended Color BASIC allows beginning programmers to build their knowledge of BASIC in a logical, understandable way. By following the examples and studying the dozens of illustrations provided, it should be a quick transition from taking your first steps to running your own BASIC programs.

TRS-80 Extended Color BASIC
Prentice-Hall, Inc.
Englewood Cliffs, NJ 07632
$12.95 paper, $19.95 cloth ©

The Flight Simulator For The Timex/Sinclair

Michael B. Williams

First came *Mazogs*, with its stunning graphics and entertaining game play. Then *3D Monster Maze*, boasting realistic, real-time movement along three-dimensional corridors. Now *The Flight Simulator* is here. And it supersedes any graphics I've ever seen on the Timex/Sinclair or ZX-81.

If you're skeptical, you won't be after you've seen it. *The Flight Simulator* challenges you to land a small, twin-engine plane safely – and it's not easy.

In all, there are three displays. The cockpit display shows the control panel and simulates the view from the inside of the airplane. As you dive and bank, you see the horizon shift through the cockpit window. On the control panel are rate-of-climb, fuel, power, and flap indicators, along with an RDF (radio direction finder) clock, and speed and gear readings.

The map display shows the area in which you are flying, including your present position, the runway, various beacons, and a mountain range rising 1500 feet above sea level. The purpose of this display is to show you your position relative to a beacon or the runway.

The third display – and the most important – is the visual display. It contains the information you will need in landing the aircraft: the altitude, speed, ILS (instrument landing system) and, of course, the cockpit display. Despite the rather low pixel resolution on the Sinclair – only 48 x 64 – the realism is outstanding. If you approach the runway at an angle, you will see it pass to your right or left with astonishing accuracy. It is even possible to notice that you are slightly off-center, due to some remarkable machine code programming.

During landing, you have complete control of the airplane, and you must make minor adjustments to align yourself with the runway. Once down, you must pull the plane to a complete stop. If, on touchdown, the screen disintegrates (indicating a crash), you have probably forgotten the landing gear. Some sort of warning that the landing gear is up would spare dozens of aircraft and who knows how many lives.

The Flight Simulator takes six to ten minutes to load, but the wait is worth it. The game so accurately simulates the flight (and for me the plight) of an aircraft that you almost feel as if you're actually piloting a plane.

The Flight Simulator
Gladstone Electronics
901 Fuhrmann Boulevard
Buffalo, NY 14203
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INSIGHT: Atari

Bill Wilkinson

I've been a bit remiss about my column recently. The editorial staff at **COMPUTE!** has covered nicely for me, splitting some of my larger articles into two parts and cutting and pasting. I shall try to make life easier for them for the next few months, since I have finally accumulated a mental backlog of material which I feel is suitable for this column.

Mind you, I can still use some input from you readers on what you would like to see, so don't stop writing. As I have stated often in the past, it doesn't seem ethical for me to review software; but that shouldn't keep me from commenting on books, hardware, and who knows what else.

And, in that vein, this isn't truly a "review," since I have not had a chance to actually try it yet, but the most interesting new product for the "serious" Atari owner that I have seen lately is the new 64K byte memory card from Mosaic Electronics. With it you can make your 800 behave just like a 1200 so far as the bank selecting of RAM versus ROM goes. Mosaic rightly points out that there is zero software currently available to take advantage of the RAM which must lie where the OS ROMs are, so perhaps the other configuration of their RAM board makes more sense. How about up to 192K bytes of RAM in an Atari 800, with all but the first 48K being bank selected in 4K hunks that reside at $C000 through $CFFF. That gives you 36 little 4K byte banks, so just imagine the graphics switching you might do (in modes 7 and below only, though)! It's not cheap, but it certainly seems like a solution looking for a problem.

Predictions Revisited

I was right on two counts! First, I said the 1200 was overpriced. But look at the prices now. I am seriously considering buying one. Or I *was*. Because I just heard that Atari is *dropping* the 1200! Welcome, welcome, Atari 600, 1400, and 1450, which were introduced at the Summer Consumer Electronics Show. All will have expansion capability like nothing Atari has built before. So watch out world: here come the add-ons. [For more on the new Atari products at CES, see Tom Halfhill's article "The Fall Computer Collection At The Summer Consumer Electronics Show" elsewhere in this issue.]

Since, by the time you read this, the announcements will have been made, you will be able to see how good my rumor sources and crystal ball gazers are. Me? I'm sitting on the edge of my chair for another week or two.

One more thing before we get to the meat of this month's column. It would appear that I fooled more than a few people with my April column. If you were fooled, I apologize. But not much. After all, April Fool articles in computer magazines are a tradition that goes back to the first days of *Datamation* (a magazine sent free to anyone who owns a computer worth more than a quarter million dollars, heavily loaded with IBM mainframe articles, but it wasn't always so). Be assured that if you were fooled you were in good company: I showed the article to a COBOL programmer with ten years experience, and she didn't get it either. (To be fair to me, though, didn't you notice the title of the column that month, "Outasight: Atari"?)

Well, enough chitchat. Shall we tackle BAIT one more time? I am not sorry to see this series end, but looking at the finished product I can honestly say that those who understand it (and know at least a smattering of machine language) should be able to tackle **COMPUTE!**'s *Atari BASIC Sourcebook*, wherein we detail the workings of a *real* interpreter.

BAIT, Part 4

This month we present the listing of BAIT in its entirety. It is not a small listing, and there is no room in a single column to recap all the details of its creation and function. So, you really need Parts 1 through 3 (which appeared in March, May, and June) if you want the full design principles.

As a very brief summary, though, let's mention the following:

1. BAIT is a very simple pseudo-BASIC interpreter which has been written in Atari BASIC.

2. BAIT accepts only single-letter statement names (as shown in the table) and single-letter variable names (A through Z).

3. BAIT allows BASIC-style screen editing, line numbering, etc., with the restriction that line numbers must be from 1 to 99.

4. There is no precedence of operators, parentheses, functions, or any other amenities. This is a *primitive* language.

Does it work? Yes. Is it useful? Only as a learning tool. Could it be made useful? If we wrote a compiler for the same language, maybe.


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New Goodies

This month, I have finally implemented the rest of the statements listed in the table. In particular, we now have Accept, Call, Fetch, New, Return, and Store available to us.

New and Return function exactly like their BASIC counterparts of the same names. Accept, Call, and Store are simply different names for BASIC's INPUT, GOSUB, and POKE, respectively. They had to be named as they are to implement the single-letter statement names.

Fetch, then, is the only strange statement. It owes its existence to the fact that BAIT doesn't allow functions. Generally, Fetch is equivalent to PEEK, but its format is that of POKE (and, naturally, Store). It does, however, require a variable to store its Fetched value in (much like GET in Atari BASIC).

The statements are fairly straightforward, and we shall see more of them a little later on. For now, though, let's analyze the additions and changes made to BAIT this month on a line-by-line basis. The lines discussed below are those which have changed or been added since the June column. If you have typed in BAIT as we have proceeded through parts 1, 2, and 3, you may enter just those lines.

• **Line 1130.** This is the stack we will use for "remembering" where Calls (GOSUBs) were made from. The size is arbitrary, but I cheated and used a fixed number, so don't change it unless you also change line 10910.

• **1720.** This makes screen editing of BAIT programs very, very much easier. See line 2300.

• **2200.** We always reset the Call stack pointer because program editing could invalidate any or all pending Return locations.

• **2300.** See line 1720. This is how we eliminate the "?" prompt from the screen when using the INPUT statement. A clever trick: use it in all your programs. It comes to you courtesy of Howard Fishman. Thanks, Howard.

• **2360.** Notice that this line (which used to strip off the question mark) is now gone. You won't miss it.

• **1540, 5520, and 5530.** The TRAP to BADVALUE was added just in case your BAIT program generated an overflow.

• **8310 and 8410.** Cosmetic changes only.

• **8500 and 8510.** A new error message. It's used for all BAIT numeric data problems.

• **10210.** A minor change to allow Print (without a following expression) to be followed by a colon statement separator.

• **10530-10550.** A fix. Without it, the Goto doesn't occur until the end of the line. Thus 'G 10 : P "oops" ' would indeed print the "oops" until now. But this fixes it.

• **10810-10860.** Finally, some new code! Actually, Accept is fairly simple and closely follows the format of Let. Instead of requiring an expression after an equals sign, though, Accept wants the user to INPUT something from the keyboard. Thanks to the TRAP, only numeric data will be allowed.

• **10910-10960.** We process the Call statement. Line 10910 seems unnecessary: who would *want* to go 50 levels deep in a BAIT program? But it works. Notice that all three vital pointers must be saved on the stack. Could it have been done more compactly? Yes, but this way is much simpler. Finally, we allow Goto to do the real work of transferring control to a new line number.

• **11110-11150.** Fetch also follows the form of Let, but in reverse. First we get an address (line 11110), then a comma (line 11120), and finally a variable to put the Fetched value into (line 11130). The TRAP of line 11140 insures that the address given was a legal one.

• **11310-11370.** Return is the opposite of Call. Again, line 11310 is for safety only; good programmers can't make mistakes like this, right? Lines 11320 to 11350 restore the information saved by Call in lines 10920 to 10950. Finally, since we saved CURLOC before we joined the Goto processing, we must skip over the line number expression to find out if there is a colon (":") waiting for us.

• **11410-11450.** Store is almost identical to Fetch. The exception: the item after the comma can be any expression at all; it does not need to be a simple variable. Again, the TRAP in line 11440 insures against illegal addresses and/or data.

Sampling The BAIT

Well, we can presume that you typed all of BAIT in properly, yes? So let's quickly try some BAIT programs, to see what you can do in the language.

Caution: The lowercase letters shown in these listings are there for clarity only! BAIT accepts *only* single-letter commands, so just leave out all lowercase letters. Do *not* convert them to uppercase. For example, the first line of Program 1 should actually be typed in as '1 S 20,0' (and even the spaces may be left out if desired).

Program 1: Tick-Tock

```
1 Store 20,0
2 Print "SHOWING HOW SLOW BAIT IS"
3 Fetch 20,T
4 Print "THAT TOOK "; : Print T; : Print "CLOCK
  TICKS"
5 End
D
B
```

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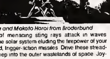

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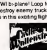

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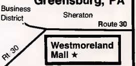

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Program 2: Recursion

```
1 Print "GIVE ME AN INTEGER NUMBER";:
  Accept N
2 Let A=1 : Call 10
3 Print "THE FACTORIAL OF YOUR NUMBER
  IS "; : Print A
4 Print : Print : Goto 1
10 If N<2 : Return
11 Let A=A*N : Let N=N -1
12 Call 10
13 Return
D
B
```

Challenge: Can you modify BAIT so that it will, indeed, ignore the lowercase letters? If so, your BAIT programs could be more readable.

Whew!

And there you have it. BAIT in all its glory. Or is that gory? Some carpers may claim that the only thing it proves is that people will try to write *anything* in BASIC. I like to think it may have provided a way for some of you to understand the mechanics of an interpreter. If it helps turn even one or two people into systems-level programmers, it will have done its job.

But if BAIT didn't interest you, don't worry. There are even a few out there that don't like to program games. (I certainly like to play them. I'm hooked on – oops, can't review software here, sorry.)

Self-relocatable Machine Language, Part 2

Last time we were on this subject, I promised to give a reason why we would want to write self-relocatable machine language. And sometimes I even keep my promises.

The primary advantage of self-relocatable code is, obviously, that you can load it and run it anywhere in memory. But why would you want to do that? Why not just decide where the code will go and leave it at that? Well, let's try to answer those questions.

First of all, none of what I am about to say pertains to programs which "take over" the system. After all, if you *know* that your code will run in such and such a way because, for example, you only give it out on a heavily protected game disk, then you can obviously place various hunks of machine language exactly where you want them. And they'll stay put.

But a large proportion of my readers are, I believe, attempting to either write machine language programs which interface to BASIC or are attempting to add on to the operating system in some way. In both these instances, self-relocatable code is invaluable.

Why? Because there simply isn't very much room in the Atari memory map that isn't used for something or other. In point of fact, the only clear portion of memory seems to be the infamous "Page Six." But, remember, even Atari BASIC can clobber the lower half of that page. And BASIC A+, Microsoft BASIC, Atari PASCAL, and several other products use portions or all of Page Six. What to do?

Well, if you have been following my articles, you will know that I advocate placing your program at LOMEM, moving LOMEM up to cover your program, and hooking into the system reset chain so that you can preserve your program if the user hits the reset key.

All well and good, but suppose LOMEM moves? And it will and it does. Depending on the number of disk drives and/or files you need to support, LOMEM can be anywhere from \$A20 (with OSS PicoDOS) to \$1D00 (standard Atari DOS) to \$2C00 (OS/A+ version 4.1). And, if the RS-232 drivers are to be loaded (for the 850 interface), you can count on LOMEM being even higher still.

What's a poor old machine language programmer supposed to do? Follow my directions, natch. Put your program at LOMEM, no matter where it is. And that's easy to do if your program is self-relocatable.

And, before we get into discussing *how* to write this magic kind of program, I would like to point out one other significant instance where self-relocatable programs are handy. Putting programs at LOMEM and moving LOMEM up is all very well and good if you can do that before BASIC gets control. But once the language is entered, it has already noted the contents of LOMEM and used them for its own initialization purposes. Changing LOMEM will not necessarily force BASIC to move its own internal LOMEM, and you may wind up with a conflict of usage.

But there is a hunk of memory which is properly handled by BASIC as far as we are concerned: strings. Any data, including a machine language program, placed in a dimensioned string is guaranteed to be moved around intact (for example, when a new program line is entered or when a new variable is introduced).

Indeed, there have been many articles published which put a machine language routine or two in a string and then call the routine via USR(ADR(strings\$),...). In fact, I have even seen a few adventuresome souls who have used ADR("some graphics and other characters here"). That is, it is perfectly O.K. to take the address of a literal string, also.

For the rest of this series, I will presume that we are writing programs which are designed to reside in Atari BASIC strings. I think that is sufficient, since there is little, if any, difference in con-

cept between placing programs in strings and placing them at a potentially movable LOMEM.

From Why To How

Let's begin by listing the things you *don't* have to worry about when writing self-relocatable programs. Some of these things were discussed briefly last month; others are new but should be fairly obvious. The following, then, are intrinsically "safe" types of machine language:

1. All instructions which involve only one or more registers (e.g., TAX, PHA, INY, etc.).

2. All load immediate instructions which do *not* involve the address of a location as the immediate value (e.g., LDA #5, but not LDY #LOCATION/256).

3. All branch instructions (BNE, BCC, etc.).

4. All instructions involving *fixed* operating system or language specific locations, either in ROM or RAM (e.g., STA LEFTMARGIN, JSR CIO).

5. Several miscellaneous instructions which do not reference memory addresses, such as SED, SEI, CLC, NOP, RTS, etc.

What about the intrinsically unsafe instructions? Here is one of them:

> Any instruction which references an absolute memory location within your own code (or another block of relocatable code) or which references a fixed RAM location which is not dedicated to the purpose intended.

Now, that's not so bad. There are a lot more safe conditions than unsafe ones, aren't there? And, yet, it takes only one unsafe instruction to clobber you, so let's concentrate on some techniques for avoiding the unsafe conditions.

Safe Relocatable Techniques

1. Change JMPs to branches. Usually, you can do a CLC followed by a BCC to substitute for a JMP. Sometimes, the target of the jump is too far away, though. In that case, add an intermediate branch point, so that the first BCC branches to a second BCC, etc.

2. Save register values on the stack (via TAX, PHA, etc.) rather than in fixed RAM locations. If you need to save a value in between calls from a higher level routine (e.g., the BASIC program), though, you will *have* to find some safe place to put it. Watch out! There are only four safe locations in zero page and only a handful in other parts of memory. More about such safe locations in the next part in this series.

3. If you need to reference bytes in a table, string, or other portion of memory, why not let BASIC handle the addressing for you? For example, consider this BASIC line:

```
TEST = USR( ADR(CODE$), ADR(TABLE$) )
```

Presuming that your machine language routine is in CODE$, it can then reference TABLE$ as follows:

```
PLA                ; parameter count
PLA
STA  ZTEMP+1       ; high byte of address
PLA
STA  ZTEMP         ; low byte of address
LDY  #0
LDA  (ZTEMP),Y     ; get first byte of the table ...
```

That program fragment is certainly intrinsically relocatable (except for the location of ZTEMP, but it needn't be preserved in between calls to the fragment). And BASIC will certainly move TABLE$ around as it needs, giving you the address when you need it.

4. If you absolutely *have* to use a hunk of nonrelocatable programming, and you don't have space to keep it on a permanent basis, why not temporarily move it from a relocatable location (e.g., TABLE$ in our example above) to a fixed location (e.g., BASIC's input buffer at $580 or some such). Then you can use it safely there, without worrying about relocatability. Of course, each time you are called from BASIC you would have to move the routine. But, as slow as BASIC is, you might never notice the extra overhead.

Next time we will continue right here. We will try to develop some even more useful techniques, including one which can only be used with USR calls from BASIC. Stay tuned.

BAIT Statements

A	Accept <variable>	(INPUT)
B	Begin	(RUN)
C	Call <line-number>	(GOSUB)
D	Display	(LIST)
E	End	
F	Fetch <address>, <variable>	(pseudo-PEEK)
G	Goto <line-number>	
I	If <expression>, <statement>	
L	Let <variable> = <expression>	
N	New	
P	Print <string-literal> Print <variable> Print	
R	Return	
S	Store <address>, <expression>	(POKE)

BAIT

```
1000 REM ..INITIALIZATION..
1001 REM ..................
1010 MAXLINE=99
1020 DIM BUFFER$(5000),LINE$(128)
1030 DIM LINES(MAXLINE)
1040 FOR LP=0 TO MAXLINE:LINES(LP)=0:NEX
     T LP
1050 BUFFER$="*"
1100 DIM C$(1),VARIABLES(26)
1110 FOR ALPHA=0 TO 26:VARIABLES(ALPHA)=
     0:NEXT ALPHA
```

```
1120 DIM ERR$(40)
1130 DIM STACK(50,2):REM MAX CALLS THUS
     IS 50
1500 REM LINE NUMBERS OF EXECUTION ROUTI
     NES
1510 PROMPT=2100:INNEXT=2300
1515 DIRECT=4700:BADLINE=8400
1520 LET GETNC=8100
1530 SYNTAX=8300:ERROR=8200:EXEXP=5000
1540 BADVALUE=8500
1550 DODISPLAY=10100:DOPRINT=10200
1560 DOBEGIN=10400:DOGOTO=10500:DOLET=10
     600:DOIF=10700
1570 DOACCEPT=10800:DOCALL=10900:DOEND=1
     1000:DOFETCH=11100
1580 DONEW=11200:DORETURN=11300:LET DOST
     ORE=11400
1700 REM MISCELLANY
1710 UNTRAP=40000
1720 OPEN #5,12,0,"E:":REM SO THERE IS N
     O ? PROMPT
2000 REM ..INTERACTION..
2001 REM ...............
2100 PRINT "READY"
2200 STACK=0:REM CLEAN UP 'CALL' STACK
2300 INPUT #5,LINE$
2350 IF LEN(LINE$)=0 THEN GOTO INNEXT
 <<< DELETED OLD LINE 2360 >>>
2370 LL=LEN(LINE$)
2500 REM CHECK FOR LINE NUMBER
2510 FOR LP=1 TO LL
2520 IF LINE$(LP,LP)<="9" AND LINE$(LP,L
     P)>="0" THEN NEXT LP
2550 REM LP HAS POSITION OF FIRST NON-NU
     MERIC CHARACTER
2560 CURLINE=0
2570 IF LP>1 THEN CURLINE=VAL(LINE$(1,LP
     -1))
2600 REM NOW SKIP LEADING SPACES, IF ANY
2610 IF LP>LL THEN 2700
2620 FOR LP=LP TO LL
2630 IF LINE$(LP,LP)=" " THEN NEXT LP
2700 REM REMOVE LINE NUMBER AND LEADING
     SPACES
2710 IF LP>LL THEN LINE$="":GOTO 3000
2720 LINE$=LINE$(LP)
3000 REM ..EDITING..
3001 REM ...........
3010 REM IF HERE, LINE NUMBER IS IN CURL
     INE
3020 LL=LEN(LINE$):REM AND LL IS LENGTH
     THEREOF
3030 IF CURLINE=0 AND LL=0 THEN GOTO PRO
     MPT
3040 IF CURLINE<>INT(CURLINE) THEN 3060
3050 IF CURLINE<=MAXLINE THEN 3100
3060 GOTO BADLINE
3100 REM FIRST, DELETE CURLINE IF IT ALR
     EADY EXISTS
3110 LENGTH=LINES(CURLINE):IF LENGTH=0 T
     HEN 3200
3120 START=INT(LENGTH/1000)
3130 LENGTH=LENGTH-1000*START
3140 BUFFER$(START)=BUFFER$(START+LENGTH
     )
3150 LINES(CURLINE)=0
3160 FOR LP=1 TO MAXLINE:TEMP=LINES(LP)
3170 IF TEMP>=START*1000 THEN LINES(LP)=
     TEMP-LENGTH*1000
3180 NEXT LP
3200 REM NOW ADD LINE TO END OF BUFFER
3210 IF LL=0 THEN GOTO INNEXT
3220 START=LEN(BUFFER$)
3230 BUFFER$(START)=LINE$
3240 BUFFER$(LEN(BUFFER$)+1)="*"
3250 LINES(CURLINE)=START*1000+LL
3300 REM NOW LINE IS IN BUFFER...WHAT DO
      WE DO
3310 IF CURLINE THEN GOTO INNEXT
3320 REM NOTE THAT CURLINE=0 AS WE FALL
     TO LINE 4000
4000 REM ..EXECUTE CONTROL..
4001 REM ..................
4010 LENGTH=LINES(CURLINE):IF LENGTH=0 T
     HEN 4600
4020 CURLOC=INT(LENGTH/1000):LENGTH=LENG
     TH-1000*CURLOC
4030 CUREND=CURLOC+LENGTH-1
4040 IF CURLINE=0 THEN CURLINE=-1
4100 REM READY TO EXECUTE A LINE
4200 REM EXECUTE A SINGLE STATEMENT
4210 GOSUB GETNC:IF NOT ALPHA THEN GOTO
     SYNTAX
4220 GOSUB 4900
4230 IF PEEK(53279)<>7 THEN GOSUB DOEND
4240 IF C$=":" THEN 4200
4250 IF C>=0 THEN GOTO SYNTAX
4600 REM COME HERE FOR NEXT LINE
4610 CURLINE=CURLINE+1
4620 IF CURLINE>0 AND CURLINE<=MAXLINE T
     HEN 4000
4700 REM ===COME HERE ON END OF DIRECT L
     INE EXECUTE===
4710 IF LINES(0) THEN BUFFER$(INT(LINES(
     0)/1000))="*"
4720 LINES(0)=0
4730 GOTO PROMPT
4900 REM THE STATEMENT CALLER
4910 ERR$="BAD STATEMENT NAME"
4920 ON ALPHA GOTO DOACCEPT,DOBEGIN,DOCA
     LL,DODISPLAY,DOEND
4930 ON ALPHA-5 GOTO DOFETCH,DOGOTO,ERRO
     R,DOIF,ERROR,ERROR
4940 ON ALPHA-11 GOTO DOLET,ERROR,DONEW,
     ERROR,DOPRINT
4950 ON ALPHA-16 GOTO ERROR,DORETURN,DOS
     TORE
4960 GOTO ERROR
5000 REM ..EXECUTE EXPRESSION..
5001 REM .....................
5010 EVAL=0:LASTOP=-1
5020 VALID=0
5100 GOSUB GETNC:IF ALPHA THEN 5300
5110 IF C$>="0" AND C$<="9" THEN 5400
5120 REM WHICH OPERATOR?
5121 IF C$="+" THEN OP=1:GOTO 5200
5122 IF C$="-" THEN OP=2:GOTO 5200
5123 IF C$="*" THEN OP=3:GOTO 5200
5124 IF C$="/" THEN OP=4:GOTO 5200
5125 IF C$=">" THEN OP=5:GOTO 5200
5126 IF C$="<" THEN OP=6:GOTO 5200
5127 IF C$="=" THEN OP=7:GOTO 5200
5128 IF C$="#" THEN OP=8:GOTO 5200
5160 IF VALID THEN RETURN
5170 GOTO 5900
5200 REM GOT AN OPERATOR
5210 IF LASTOP>0 THEN 5170
5220 IF LASTOP<0 AND OP>2 THEN 5170
5230 LASTOP=OP:VALID=0:GOTO 5100
5300 REM GOT A VARIABLE
```

```
5310 VAL2=VARIABLES(ALPHA):GOTO 5500
5400 REM GOT A NUMERIC
5410 CURLOC=CURLOC-1:REM BACKUP TO FIRST
     NUMERIC
5420 FOR LL=CURLOC TO CUREND:C$=BUFFER$(
     LL)
5430 IF (C$>="0" AND C$<="9") OR C$="."
     THEN NEXT LL
5440 VAL2=VAL(BUFFER$(CURLOC,LL-1))
5450 CURLOC=LL
5500 REM VAR OR NUMERIC
5510 IF LASTOP=0 OR ABS(LASTOP)>8 THEN 5
     900
5520 TRAP BADVALUE:GOSUB 5600+10*ABS(LAS
     TOP)
5530 TRAP UNTRAP:LASTOP=0:VALID=1:GOTO 5
     100
5600 REM EXECUTE OPERATORS
5610 EVAL=EVAL+VAL2:RETURN
5620 EVAL=EVAL-VAL2:RETURN
5630 EVAL=EVAL*VAL2:RETURN
5640 EVAL=EVAL/VAL2:RETURN
5650 EVAL=(EVAL>VAL2):RETURN
5660 EVAL=(EVAL<VAL2):RETURN
5670 EVAL=(EVAL=VAL2):RETURN
5680 EVAL=(EVAL<>VAL2):RETURN
5900 ERR$="INVALID EXPRESSION":GOTO ERRO
     R
8000 ..MISCELLANEOUS SUBROUTINES..
8001 REM ........................
8100 REM GETNC
8110 IF CURLOC>CUREND THEN C=-1:C$=CHR$(
     155):GOTO 8140
8120 C=ASC(BUFFER$(CURLOC)):C$=CHR$(C)
8130 CURLOC=CURLOC+1
8140 IF C=32 THEN GOTO GETNC
8150 ALPHA=(C$>="A" AND C$<="Z")*(C-64)
8160 RETURN
8200 REM ERROR ROUTINE
8210 PRINT :PRINT "***";ERR$;"***";
8220 IF CURLINE>0 THEN PRINT " AT LINE "
     ;CURLINE
8230 PRINT :TRAP 8250
8240 POP :POP :POP :POP :POP :POP :POP :
     POP
8250 TRAP UNTRAP
8290 GOTO DIRECT
8300 REM SYNTAX ERROR
8310 ERR$="SYNTAX ERROR":GOTO ERROR
8400 REM BAD LINE NUMBER
8410 ERR$="BAD LINE NUMBER":GOTO ERROR
8500 REM VALUE OUT OF RANGE ERROR
8510 ERR$="BAD VALUE":GOTO ERROR
10000 REM ..EXECUTE THE VARIOUS STATEMEN
     TS..
10001 REM ............................
     ....
10100 REM ==EXECUTE DISPLAY==
10110 FOR LP=1 TO MAXLINE
10120 LENGTH=LINES(LP):IF LENGTH=0 THE 1
     0150
10130 START=INT(LENGTH/1000):LENGTH=LENG
     TH-1000*START
10140 PRINT LP;" ";BUFFER$(START,START+L
     ENGTH-1)
10150 NEXT LP
10190 GOTO GETNC
10200 REM ==EXECUTE PRINT==
10210 GOSUB GETNC:IF C<0 OR C$=":" THEN
     PRINT :RETURN
10220 IF C=34 THEN 10300
10230 CURLOC=CURLOC-1
10240 GOSUB EXEXP:PRINT EVAL;
10250 IF C$=";" THEN GOTO GETNC
10260 IF C$="," THEN PRINT ,:GOTO GETNC
10270 PRINT :RETURN
10300 FOR LL=CURLOC TO CUREND:C$=BUFFER$
     (LL)
10310 IF ASC(C$)<>34 THEN PRINT C$;:NEXT
     LL:PRINT :RETURN
10320 CURLOC=LL+1:GOSUB GETNC
10330 GOTO 10250
10400 REM ===EXECUTE BEGIN===
10410 FOR ALPHA=0 TO 26:VARIABLES(ALPHA)
     =0:NEXT ALPHA
10420 CURLINE=0:C=-1:RETURN
10500 REM ===EXECUTE GOTO===
10510 GOSUB EXEXP
10520 IF LINES(EVAL)=0 THEN ERR$="NO SUC
     H LINE":GOTO 8200
10530 CURLINE=EVAL-1
10540 C=-1:C$=""
10550 RETURN
10600 REM ===EXECUTE LET===
10610 GOSUB GETNC:IF NOT ALPHA THEN GOTO
     SYNTAX
10620 DESTVAR=ALPHA
10630 GOSUB GETNC:IF C$<>"=" THEN GOTO S
     YNTAX
10640 GOSUB EXEXP:VARIABLES(DESTVAR)=EVA
     L
10650 RETURN
10700 REM ===EXECUTE IF===
10710 GOSUB EXEXP
10720 IF NOT EVAL THEN C=-1:C$=""
10730 RETURN
10800 REM ===EXECUTE ACCEPT===
10810 GOSUB GETNC:IF NOT ALPHA THEN GOTO
     SYNTAX
10820 TRAP 10850:INPUT EVAL:TRAP UNTRAP
10830 VARIABLES(ALPHA)=EVAL
10840 GOTO GETNC
10850 PRINT "??? MUST INPUT A NUMBER, RE
     PEAT..."
10860 GOTO 10820
10900 REM ===EXECUTE CALL===
10910 IF STACK=50 THEN ERR$="TOO MANY CA
     LLS":GOTO ERROR
10920 STACK(STACK,0)=CURLOC
10930 STACK(STACK,1)=CUREND
10940 STACK(STACK,2)A=CURLINE
10950 STACK=STACK+1
10960 GOTO DOGOTO
11000 REM ===EXECUTE END===
11010 PRINT"===END AT LINE ";CURLINE;"==
     "
11020 C=-1:CURLINE=C:C$=""
11030 RETURN
11100 REM ===EXECUTE FETCH===
11110 GOSUB EXEXP
11120 IF C$<>"," THEN GOTO SYNTAX
11130 GOSUB GETNC:IF{2 SPACES}NOT ALPHA
     THEN GOTO SYNTAX
11140 TRAP BADVALUE:VARIABLES(ALPHA)=PEE
     K(EVAL)
11150 TRAP UNTRAP:GOTO GETNC
11200 REM ===EXECUTE NEW===
11210 RUN
11300 REM ===EXECUTE RETURN===
11310 IF STACK=0 THEN ERR$="NO MATCHING
```

```
       CALL":GOTO ERROR
11320 STACK=STACK-1
11330 CURLOC=STACK(STACK,0)
11340 CUREND=STACK(STACK,1)
11350 CURLINE=STACK(STACK,2)
11360 GOSUB EXEXP:REM IGNORE...ALREADY P
      ROCESSED
11370 RETURN
11400 REM ===EXECUTE STORE===
11410 GOSUB EXEXP:ADDRESS=EVAL
11420 IF C$<>"," THEN GOTO SYNTAX
11430 GOSUB EXEXP
11440 TRAP BADVALUE:POKE ADDRESS,EVAL
11450 TRAP UNTRAP:RETURN
```
©

Converting VIC And 64 Programs To PET

Jim Butterfield, Associate Editor

This handy, short program will automatically fix VIC or 64 programs so they will run correctly on the PET/CBM.

BASIC programs move freely from PET, VIC, or Commodore 64 to the VIC or 64. But they don't flow easily to the PET from the other machines.

If you have a disk, this "Program Converter" will convert your BASIC programs easily and quickly. It will run on PET, VIC, or Commodore 64. The programs must be free from special PEEKs and POKEs, of course; but regular BASIC will work fine on any machine. Program Converter just helps you load it to the PET.

Programs which have been converted will load to any machine: PET, VIC (any memory configuration), and Commodore 64. Before conversion, the PET wasn't in the list; the other machines were capable of adjusting to "foreign" programs.

Type in Program Converter and run. It will ask you for the name of the program you wish to convert (say, a BASIC program written on the 64). Enter the name, and it will then ask you for the new name you wish to give to the converted program. Supply the name, and the job's under way.

If you have a dual drive, the new program will always be written to drive zero. After you have converted the program, the new version will still load without problems to the VIC or 64, but will also load to a standard PET.

The Program

```
100 PRINT "VIC/64 TO PET"
110 PRINT "PROGRAM CONVERTER"
120 PRINT
130 X=150:POKE X,127
140 IF ST<>127 THEN X=144
150 DATA 162,1,32,198,255,32,228,255,166
    ,150,8,72,32,204,255
160 DATA 162,2,32,201,255,104,32,210,255
    ,32,204,255,40,240,226,96
170 FOR J=828 TO 858 :READ A:POKE J,A:T=T
    +A:NEXT J
180 POKE 837,X:IF T<>4396 THEN STOP
200 CLOSE1:CLOSE2:CLOSE15
210 OPEN 15,8,15
220 INPUT "BASIC PROGRAM";B$
230 OPEN 1,8,3,B$+",P,R"
240 INPUT #15,E,E$,E1,E2
250 IF E THEN PRINT E$:GOTO 200
260 GET #1,A$,B$
270 IF A$<>CHR$(1) THEN PRINT "OOPS!":GO
    TO 200
280 INPUT "NEW NAME";N$
290 OPEN 2,8,4,"0:"+N$+",P,W"
300 INPUT #15,E,E$,E1,E2
310 IF E THEN PRINT E$:GOTO200
320 PRINT #2,A$;CHR$(4);
330 SYS 828
340 CLOSE2:CLOSE1:CLOSE15
350 PRINT"DONE."
```

The Machine Language

It may be instructive to examine the simple machine language program which does the job. Machine language isn't vital, of course; it just speeds things up. Let's look at it. At the time this part of the program runs, the files have been opened.

Get a character from the input:

```
     (connect the input)
033C A2 01      LDX   #$01
033E 20 C6 FF   JSR   $FFC6
     (get the character)
0341 20 E4 FF   JSR   $FFE4
     (get ST and stack it away)
     (on VIC/64, STATUS is hex 90)
0344 A6 96      LDX   STATUS
0346 08         PHP
     (stack the input character)
0347 48         PHA
     (disconnect the input)
0348 20 CC FF   JSR   $FFCC
     (connect the output)
034B A2 02      LDX   #$02
034D 20 C9 FF   JSR   $FFC9
     (get character and send)
0350 68         PLA
0351 20 D2 FF   JSR   $FFD2
     (disconnect the output)
0354 20 CC FF   JSR   $FFCC
     (recall ST from stack)
0357 28         PLP
0358 F0 E2      BEQ   REPEAT
     (quit if ST non-zero)
035A 60         RTS
```

If you type Program Converter into a VIC or 64, you might like to have it convert itself. That way, you'll have a universal program converter, one that will work on the PET. By the way, the machine language won't get in the way, since it's POKEd into place by the BASIC program.

How To Create A Data Filing System

Part II. Planning The Output

Jim Fowler

Part I of this article covered the goals to keep in mind and the kinds of disk files that could be used in a data filing system. From painful experience, I can tell you that the most important planning begins with the output functions of a program. This will determine the best way to file the data. That will, in turn, define the nature of the input functions. There are two aspects to the problem: how to encode the data and how to search the file. Again, it's best to work backwards. Let's look at searching first.

Searching Takes Time

Let's say you want to search your file. You have data that you want to match up with data in the file – maybe an author's name – and you want the titles of the books by that author. The author's name will be used as the *key*, and you want to retrieve all the records having an author's name identical to the key.

First, you have arranged the data within the records so the program can find the author's name. Maybe it is the first 16 bytes in the record. You can read that from the disk and compare it to the key. If they match, you have a *hit*, otherwise you have a *miss*. Maybe you want all the hits to be printed or displayed on the screen. Maybe you want both, or, as I arranged to do in one of my programs, you can preview a hit on the screen and opt to have it printed for later use.

However, there is a serious problem here. It may take only a second or two to get the author's name from the disk, and the comparison with the key runs quite fast. But if you have a thousand records to search through at one second each, it's going to take about 20 minutes to go through the file – and that's not allowing any time for the printer to print or the user to preview records on the screen. You could flip through a lot of cards in a card file in 20 minutes. How can you get around this?

Creating An Index File

The answer is an *index file*; see Figure 1. You keep a separate file of authors' names, probably in the same order as the records on the disk. Because this file sits in RAM, searching is much faster. Furthermore, you may be able to make the program search while contemplating the last hit on the screen, or while the printer is printing. Then, the only delay is in retrieving the first hit. After that, the search appears instantaneous. Index files are almost a necessity if you have many records and want to retrieve them in anything other than top-to-bottom order. Even a mailing list ought to be retrievable in alphabetical order or by zip code, for example.

This brings up another problem: the index file (or files) will have to be recorded on the disk, too. The longer the file, the longer it will take to save it when you are through entering data – and the more space you will need in RAM. So give thought to keeping index files as short as you can and as easy to save as possible. This means using index words (entries into the index file) which are both short and packed with information. Look at your data with this in mind.

I found that last names can usually be reduced to the first eight letters. The number of false hits is quite tolerable, especially if you plan to preview the hits for other reasons. Now and then you will look for WADSWORTH and get WADSWORTHENSON, but that has to be traded off against using a nine-letter index word which makes a thousand-record index a thousand bytes longer. You will have to compromise somewhere.

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• **LONG LIFE PRINT HEAD:** 100 million character life expectancy.

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• **PROGRAMMABLE LINE FEED:** programmable length from 1/144 to 255/144 inches.

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ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

Two Kinds Of Search

Another consideration is that there are two fundamentally different kinds of search. One is a match: like the author's name, it's an identity match. The other is a *topic* match. An example of this is looking for books on certain subjects. In this second case, the subjects are "contained in" the record, but the book might also include subjects you haven't asked for and don't care about. The match isn't an identity; let's call it a "contained-in" match. How you implement this depends on how you encode the information on subjects.

I recommend that you use a bitmap type of code as illustrated in Figure 2. Program 1 gives a sample "identity search" in both BASIC and machine language. Program 2 does the same for the "contained-in" search.

There are a few techniques you need to use. First, you set up a general buffer to use in inputting keys and index words. The same routine used for generating an index word (say, from an author's last name) can be used to put the comparable index word into this buffer. Carefully consider how you encode the data in light of your retrieval problems. A few hours at this stage can make a tremendous difference in the result.

If your key for an identity search is not as long as the index words compared with it, fill the rest of the space with nulls. In the search routine (as shown in the programs) the program returns as soon as it hits a null. That way you can input "SMITH" and find all the Smiths or even just "S" and get all the authors whose names start with S.

If you want to retrieve records by a combination of these search methods, you can do it by using them in sequence. For example, do an identity search first. Then, when you have a hit, check for the second kind, the contained-in search. If the record passes both tests, you have a full hit. This allows you to set up keys that are a mixture of "must-have" and "don't-care" data.

Record Formatting

Now it is time to decide how your records are to be set up. If you are using relative records (each record the same length – like pigeonholes), you have the same arrangement problem within a record as you had deciding the type of record to use.

Your record can be divided up into "fields." Each record will have the same size fields. One field will be the author's name, another the year of publication (four bytes can encode a four-digit year, or you can subtract 1792 from the year and encode all the years from 1792 to 2047 with only one byte). Each field will have to be big enough to hold the largest string of data you will ever want to store there. Book titles in my file take 80 bytes, and even then I have to condense the longer titles.

Take your time deciding your record format. Since you will be reading a record from the disk only to display it (not for searching purposes), it is best to have the data in a few long strings rather than in shorter chunks. Author and year could be one ASCII string – then the input from the disk and the display on the screen (or printer) is easy to program. Numeric data can be either floating point or integer.

Working with output is the next step, and we'll cover that in the next issue.

Figure 1: Index files contain parts of records for rapid searching.

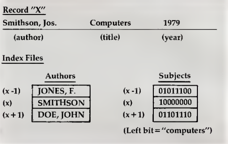
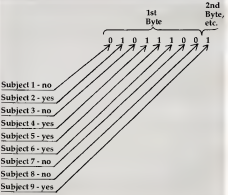


Figure 2: Subjects or other yes-no data can be coded by individual bits.



Program 1:
Identity Search In BASIC And Machine Language

Start with SYS (or JSR) to "BEGIN"; routine will return with number of record hit in register. If that

number is zero, then no more hits. After a hit, continue search with SYS (or JSR) to "DECPT."

"BEGIN" Put KEY into BUFFER.
Set POINTER from NEXT EMPTY RECORD No.

"DECPT" Decrement POINTER by one. If zero, then RETURN.

(in BASIC)

```
10 AD=POINTER*LEN+OFFSET
20 FOR I=0  TO LEN-1
30 X=PEEK(BUFFER+I)
40 IF X=0 THENRETURN
50 IF PEEK(AD+I)<>X  GOTO"DECPT"
60 NEXTI:RETURN
```

(in machine language)

Put POINTER*LEN in REGISTER
Add OFFSET to REGISTER

```
      LDY #0
"CONT"LDA (REGISTER),Y
      BEQ "END"
      CMP (BUFFER),Y
      BNE "DECPT"
      INY
      CPY #LEN
      BCC "CONT"
 "END"RTS
```

Note: LEN = index word length
OFFSET = address of zero'th index word

Program 2:
Contained-in Search In BASIC And Machine Language

The operation is similar to routine in Program 1.

"BEGIN" Put KEY into BUFFER.
Set POINTER from NEXT EMPTY RECORD No.

"DECPT" Decrement POINTER by one. If zero, then RETURN.

(in BASIC)

```
10 AD=POINTER*LEN+OFFSET
20 FOR I=0  TO LEN-1
30 X=PEEK(BUFFER+I)
40 IF(PEEK(AD+I)ANDX)<>X THEN RETURN
50 NEXTI:RETURN
```

(in machine language)

Put POINTER*LEN in REGISTER
Add OFFSET to REGISTER

```
      LDY #0
"CONT"LDA(POINTER),Y
      EOR #$FF
      EOR (BUFFER),Y
      INY
      CPY #LEN
      BCC "CONT"
      RTS
```

Note: LEN is index word length
OFFSET is address of zero'th index word.

Neat Numbers On The VIC

Daniel E. Dick

These subroutines will print numbers and display calculations on a TV or a printer in easily read columns. There are several solutions here to common formatting problems.

I use a VIC-20 and VIC-1515 printer in designing programs for my work in energy studies. I find that the familiar TAB and the CHR$(16) functions leave something to be desired when you are sending numbers to a monitor or printer. Both TAB and CHR$ left justify columns of numbers. The VIC-20 also does not include a PRINT USING statement for right justifying columns of numbers or for placing commas between numerical units in the thousands.

As you can see from these examples:

99999 is more easily read as 99,999
12345678 is more easily read as 12,345,678

And a column of numbers is more easily read (and checked for addition) if it is right justified as well. The column of numbers to the right is easier to read and total:

50.65	50.65
1.10	1.10
250.40	250.40
2500.00	2500.00

Program 1 is a short and simple program to right justify and display real numbers on the screen.

Input	Output
.01	.01
.1	.1
1	1
1.2	1.2
1.21	1.21
11	11
11.2	11.2
11.21	11.21
111	111
111.21	111.21

Program 2 right justifies and prints integers up to 999999999 (999,999,999) – VIC's limit of standard notation.

INPUT	OUTPUT
9	9
99	99
999	999
9999	9,999
99999	99,999
999999	999,999
9999999	9,999,999
99999999	99,999,999
999999999	999,999,999

Program 3 right justifies and prints real numbers up to 9999999.99 (9,999,999.99) which is the limit of standard notation in the VIC-20.

INPUT	OUTPUT
.09	.09
.9	.90
9	9.00
9.99	9.99
99	99.00
99.99	99.99
999	999.00
9999	9,999.00
99999.5	99,999.50
999999	999,999.00
9999999	9,999,999.00

Program 4 displays and prints specific data and calculated results in a tabular form that is legible and understandable. Programs 2 and 3 have been integrated into the main program in lines 5000-5050 and 5100-5180.

Lines 10000-10050 are a helpful subroutine for renumbering lines (published in **COMPUTE!**, April 1982).

Your Energy Consumption For Space Heat During Year Chosen:

NO. UNITS	UNIT	FUEL	UNIT COST	FUEL COST
1,100.00	GALS	OIL	1.27	1,397.00
1,450.00	CCF	NATURAL GAS	.65	942.50
12,345.00	KWH	ELECTRICITY	.09	1,111.05
5.50	CORDS	WOOD	95.00	522.50
4.75	TONS	COAL	166.00	788.50
			TOTAL COST	$ 4,761.55

NO. UNITS	UNIT	FUEL	BTU/UNIT	BTU'S CONSUMED
1,100.00	GALS	OIL	140,000	154,000,000
1,450.00	CCF	NATURAL GAS	100,000	145,000,000
12,345.00	KWH	ELECTRICITY	3,414	42,145,830
5.50	CORDS	WOOD	20,000,000	110,000,000
4.75	TONS	COAL	20,000,000	95,000,000
			TOTAL	546,145,830

Program 5 brings us back full circle to Program 1, with line 15 transferring control to the printer.

OUTPUT
.01
.1
1
10
100
1000

Program 1:
Right-Justified Real Numbers Displayed On Screen

```
10 REM..RIGHT JUSTIFY TO SCREEN
20 INPUT"A NUMBER";N
30 IF N=>1 THEN PRINT TAB(15-LEN(STR$(IN
   T(N))))N
40 IF N<1 THEN PRINT TAB(14)N
50 GOTO 20
60 END
```

Program 2:
Right-Justified Integers Up Ta 999999999

```
10 REM..RIGHT JUSTIFY2
20 OPEN1,4
25 PRINT#1,CHR$(16)"Ø7INPUT";CHR$(16)"46
   OUTPUT"
27 PRINT#1,CHR$(16)"Ø7{5 T}";CHR$(16)"
   46{6 T}":PRINT#1
30 INPUT"A NUMBER";N
40 IF N<1 THEN PRINT TAB(14)N
50 BL$="{11 SPACES}"
60 GOSUB 900
70 PRINT#1,CHR$(16)"Ø6"N;CHR$(16)"40"S$
80 GOTO 30
90 CLOSE1,4
900 N=INT(N):S$=STR$(N)
910 L=LEN(S$):S$=MID$(S$,1,L)
920 S$=RIGHT$(BL$,10-L)+S$
930 IF N<=999 THEN S$=LEFT$(S$,7)+"
    {2 SPACES}"+RIGHT$(S$,3)
940 IF N>999 AND N<=999999 THEN S$=" "+L
    EFT$(S$,7)+","+RIGHT$(S$,3)
950 IF N>999999 THEN S$=LEFT$(S$,4)+","+
    MID$(S$,5,3)+","+RIGHT$(S$,3)
970 RETURN
```

Program 3:
Right-Jusfified Real Numbers up ta 9999999.99

```
10 REM..RIGHT JUSTIFY3
20 OPEN1,4
25 PRINT#1,CHR$(16)"Ø7INPUT";CHR$(16)"46
   OUTPUT"
27 PRINT#1,CHR$(16)"Ø7{5 T}";CHR$(16)"
   46{6 T}":PRINT#1
30 INPUT"A NUMBER";N
32 DEF FNR(N)=(INT(100*N+0.5))/100
34 N=FNR(N)
40 W=N*100
50 BL$="{13 SPACES}"
60 GOSUB 900
70 PRINT#1,CHR$(16)"Ø6"N;CHR$(16)"37"S$
80 GOTO 30
90 CLOSE1,4
900 S$=STR$(W)
910 L=LEN(S$):S$=MID$(S$,1,L)
913 IF L=2 THEN S$=MID$(BL$,1,12)+".Ø"+R
    IGHT$(S$,1):RETURN
915 D$="."+RIGHT$(S$,2)
917 S$=LEFT$(S$,L-2)+D$
920 S$=RIGHT$(BL$,12-L)+S$
930 IF N<=999.99 THEN S$=LEFT$(S$,7)+"
    {2 SPACES}"+RIGHT$(S$,6)
940 IF N>999.99 AND N<=999999.99 THEN S$
    =" "+LEFT$(S$,7)+","+RIGHT$(S$,6)
950 IF N>999999.99 THEN S$=LEFT$(S$,4)+"
    ,"+MID$(S$,5,3)+","+RIGHT$(S$,6)
970 RETURN
```

Program 4:
Numerical Data Displayed And Printed In Tabular Format

```
20 REM..ENERGY ANALYSIS1
30 OPEN1,4
40 PRINT#1:PRINT#1
50 GOTO 290
```

Standard VIC 20

no additional memory needed

(CG008) Alien Panic $12.95

Race against time as your guy digs holes to trap aliens in 4 floor laddered, brick construction site. Requires joystick.

(CG096) Antimatter Splatter $24.95

This game is as good as its name. Another pure machine code game, this one is fast! The alien at the top of the screen is making a strong effort to rid the world of humankind by dropping antimatter on them. The splatter cannon and you are our only hope as more and more antimatter falls. Joystick again is optional equipment.

(CG026) Collide $12.95

"Vic" controls one, you the other as cars go opposite directions on 4 lane track. Requires joystick.

(CG094) Exterminator $24.95

Recently scoring a rating of 10 out of a possible 10 this game was praised as "one of the best I've seen on any computer" by a prominent reviewer in a leading magazine. The idea is to shoot a centipede before it overuns you, the problem being every time you hit it, it divides into two separate shorter ones. Several other little creatures bounce around during this struggle. All of them lethal. 100% machine language makes the rapid fire action very smooth. A joystick is optional, but as always, recommended, (a trac ball is also very nice!).

(CG054) Krazy Kong $12.95

Three screens, a gorilla, barrels, and changing difficulty levels help to make this one of our most popular. Joystick optional.

(CG098) Racefun $19.95

Extensive use of multicolored character capabilities of the "Vic" make this one very appealing to the eye. Fast all machine language action, quick response to the stick or keyboard controlled throttle, combine with the challenge of driving in ever faster traffic to make it appeal to the rest of the body. Joystick controlling is an option.

(CG058) Rescue From Nufon $12.95

Must find 30 hostages in this 100 room, 5 story, alien infested, graphic adventure game. A continual big seller. Keyboard only (n. = north w = west etc.)

(CG068) The Catch . . . $12.95

Another all machine language game based on the principle that one person with one joystick guiding one catch/shield can catch everything that one alien can throw at one. The action comes slowly at first but by the fourth wave you'll be aware of . . . "The Catch" . . .

Expanded Memory Vic 20 Games

(CG090) Defender On Tri $19.95

Pilot a defender style ship on mission to save trapped scientists from a fiery fate (they are aboard an alien vessel deep in the gravity well of sol). Excellent graphics. Short scene setting story in the instructions. "Defender On Tri" requires at least 3K added memory.

(CG092) 3D Man $19.95

The maze from probably the most popular arcade game ever, with perspective altered from overhead to eye level. The dots, the monsters, the power dots, the side exits, the game is amazing. "3D Man" requires at least 3K added memory.

(CG088) Space Quest $19.95

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Commodore 64

(CG602) 3D-64, Man $19.95

This available on the expanded "Vic 20" game, has been completely rewritten for the 64 and uses sprites, sounds, and other features not available on the "Vic". This one requires a joystick.

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```
290 PRINT#1,"YOUR ENERGY CONSUMPTION FOR
    SPACE HEAT DURING YEAR CHOSEN:"
300 DIM QUAN(5),QUAN$(5),UNIT$(5),FUEL$(
    5),CST(5),CST$(5),ENCST(6),ENCST$(6)
310 PRINT#1
320 PRINT#1,CHR$(16)"08NO.UNITS";CHR$(16
    )"20UNIT";CHR$(16)"30FUEL";
330 PRINT#1,CHR$(16)"51UNIT COST";CHR$(1
    6)"66FUEL COST"
340 PRINT#1,CHR$(16)"08{8 T}";CHR$(16)
    "20{4 T}";CHR$(16)"30{11 T}";
350 PRINT#1,CHR$(16)"51{9 T}";CHR$(16)
    "66{9 T}"
360 PRINT#1
370 PRINT"{CLR}INPUT GALS OF FUEL OIL":I
    NPUT QUAN(1)
380 PRINT"INPUT DECIMAL COST PER GAL":IN
    PUT CST(1)
390 PRINT"INPUT CCF OF NATURAL GAS":INPU
    T QUAN(2)
400 PRINT"INPUT DECIMAL COST PER CCF":IN
    PUT CST(2)
410 PRINT"INPUT KWH OF ELECTRICITY":INPU
    T QUAN(3)
420 PRINT"INPUT DECIMAL COST PER KWH":IN
    PUT CST(3)
430 PRINT"INPUT CORDS OF WOOD":INPUT QUA
    N(4)
440 PRINT"INPUT DECIMAL COST PER CORD":I
    NPUT CST(4)
450 PRINT"INPUT TONS OF COAL":INPUT QUAN
    (5)
460 PRINT"INPUT DECIMAL COST PER TON":IN
    PUT CST(5)
470 PRINT"WANT TO CHANGE ANY INPUTS(Y/N)
    ":INPUT C$
480 IF C$="Y" THEN GOTO 370
490 BS$="{12 SPACES}"
500 FOR R=1 TO 5
510 READ UNIT$(R),FUEL$(R)
520 ENCST(R)=QUAN(R)*CST(R)
530 ENCST(6)=ENCST(6)+ENCST(R)
540 N=QUAN(R):W=N*100:GOSUB 5100:QUAN$(R
    )=S$
550 N=CST(R):W=N*100:GOSUB 5100:CST$(R)=
    S$
560 N=ENCST(R):W=N*100:GOSUB 5100:ENCST$
    (R)=S$
570 PRINT#1,CHR$(16)"01"QUAN$(R);CHR$(16
    )"20"UNIT$(R);CHR$(16)"30"FUEL$(R);
580 PRINT#1,CHR$(16)"45"CST$(R);CHR$(16)
    "60"ENCST$(R)
590 NEXT R
600 DATA GALS,OIL,CCF,NATURAL GAS,KWH,EL
    ECTRICITY,CORDS,WOOD,TONS,COAL
610 PRINT#1
615 N=ENCST(6):W=N*100:GOSUB 5100:ENCST$
    (6)=S$
620 PRINT#1,CHR$(16)"64{12 T}"
630 PRINT#1,CHR$(16)"45TOTAL COST
    {2 SPACES}$";CHR$(16)"60"ENCST$(6)
640 PRINT#1
650 GOTO 920
920 PRINT"WAIT FOR PRINTER TO COMPLETE T
    HIS SECTION":PRINT
930 DIM UBTU(5),UBTU$(5),BTUC(6),BTUC$(6
    )
940 PRINT#1,CHR$(16)"08NO.UNITS";CHR$(16
    )"20UNIT";CHR$(16)"30FUEL";
950 PRINT#1,CHR$(16)"49BTU/UNIT";CHR$(16
    )"65BTU'S CONSUMED"
960 PRINT#1,CHR$(16)"08{8 T}";CHR$(16)
    "20{4 T}";CHR$(16)"30{12 T}";
970 PRINT#1,CHR$(16)"49{8 T}";CHR$(16)
    "65{14 T}"
980 PRINT#1
990 FOR R=1 TO 5
1000 UBTU(1)=140000:UBTU(2)=100000:UBTU(
     3)=3414:UBTU(4)=20000000
1010 UBTU(5)=20000000
1020 BTUC(R)=QUAN(R)*UBTU(R)
1030 BTUC(6)=BTUC(6)+BTUC(R)
1040 N=QUAN(R):W=N*100:GOSUB 5100:QUAN$(
     R)=S$
1050 N=UBTU(R):GOSUB 5000:UBTU$(R)=S$
1060 N=BTUC(R):GOSUB 5000:BTUC$(R)=S$
1070 PRINT#1,CHR$(16)"01"QUAN$(R);CHR$(1
     6)"20"UNIT$(R);
1080 PRINT#1,CHR$(16)"30"FUEL$(R);CHR$(1
     6)"45"UBTU$(R);CHR$(16)"65"BTUC$(R)
1090 NEXT R
1095 N=BTUC(6):GOSUB 5000:BTUC$(6)=S$
1100 PRINT#1,CHR$(16)"65{14 T}"
1110 PRINT#1,CHR$(16)"50TOTAL";CHR$(16)"
     65"BTUC$(6)
1120 PRINT#1
1130 PRINT#1
1140 PRINT
1145 END
5000 N=INT(N):S$=STR$(N)
5010 L=LEN(S$):S$=MID$(S$,1,L):S$=RIGHT$
     (BS$,10-L)+S$
5020 IF N<=999 THEN S$=LEFT$(S$,7)+"
     {2 SPACES}"+RIGHT$(S$,3)
5030 IF N>999 AND N<=999999 THEN S$=" "+
     LEFT$(S$,7)+","+RIGHT$(S$,3)
5040 IF N>999999 THEN S$=LEFT$(S$,4)+","
     +MID$(S$,5,3)+","+RIGHT$(S$,3)
5050 RETURN
5100 S$=STR$(W):L=LEN(S$):S$=MID$(S$,1,L
     )
5110 IF L=2 THEN S$=MID$(BS$,1,12)+".0"+
     RIGHT$(S$,1):RETURN
5120 D$="."+RIGHT$(S$,2)
5130 S$=LEFT$(S$,L-2)+D$
5140 S$=RIGHT$(BS$,12-L)+S$
5150 IF N<=999.99 THEN S$=LEFT$(S$,7)+"
     {2 SPACES}"+RIGHT$(S$,6)
5160 IF N>999.99 AND N<=999999.99 THEN S
     $=" "+LEFT$(S$,7)+","+RIGHT$(S$,6)
5170 IF N>999999.99 THEN S$=LEFT$(S$,4)+
     ","+MID$(S$,5,3)+","+RIGHT$(S$,6)
5180 RETURN
9000 REM PAUSE TO READ SCREEN
9010 PRINT"HIT 'RETURN' KEY TO CONTINUE"
9020 INPUT CONT$:RETURN
9990 END
10000 REM..RENUMBER LINES1
10010 Y6=4096:Y7=10
10020 IF PEEK(Y6+3)=6 AND PEEK(Y6+4)=39
      THEN END
10030 Y8=INT(Y7/256):Y9=Y7-256*Y8:POKE Y
      6+3,Y9:POKE Y6+4,Y8
10040 IF PEEK(Y6+5)<>0 THEN Y6=Y6+1:GOTO
      10040
10050 Y7=Y7+10:Y6=Y6+5:GOTO 10020
```

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Program 5:
Shorter Version Of Right-Justified Real Numbers

```
10 REM..RIGHT JUSTIFY TO PRINTER
15 OPEN1,4:CMD1
18 PRINT TAB(40)"OUTPUT"
19 PRINT TAB(40)"{6 T}":PRINT
20 INPUT N
30 IF N=>1 THEN PRINT TAB(40-LEN(STR$(IN
   T(N))))N
40 IF N<1 THEN PRINT TAB(39)N
50 GOTO 20
60 END
```

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Atari Verify

Michael J Barkan

Using less than 1K of memory, this utility program for cassette can save you a lot of time and frustration.

I had recently made a CSAVE *and* a LIST"C:" (after about five hours of typing) and *neither* of them had saved the program. This sort of thing is more than distressing. My solution is neither elaborate nor entirely original, but it works.

Ed Stewart's article in *COMPUTE!'s Second Book of Atari* on backing up machine language tapes served as the inspiration for my program. Stewart's program reads a block of data from the cassette tape, puts it in a string, reads another block, adds it to the string, and so on. The string eventually contains the entire program. Of course, the string needs to be as big as the computer's memory, so I couldn't use the method directly.

I know absolutely nothing about machine language except that when I try to change something, the system crashes – so I didn't change anything. The trick was to fool the machine language program. Locations 203 and 204 (decimal) contain the starting address of string A$. All I had to do (sounds easy, now) was reset these locations so that the machine language subroutine would "forget" that it had already put something into A$. This means that A$ needs to hold a maximum of only 128 bytes, the size of one cassette data block. Therefore, this program, once running, takes up less than 1K of memory; A$ just keeps reusing the same 128 bytes.

To use this utility, type it in and save it with LIST"C:". Load the program you want to save, or start typing in a new program. Make sure your program starts at line 10 or higher. CSAVE it. Now ENTER"C:" this utility and run it. It will ask you to start loading the tape with your new program. If the tape runs all the way through and ends with an end-of-file flag, you'll get a "GOOD TAPE" message. If the tape is not readable, you'll get an error message (my favorite is 143), but *your program is still in the computer*, so you can try again. Delete lines 0 through 9 first, though.

If your tape is of the ENTER"C:" variety, just change the 255 in line 4 to 0, and the program will verify it, too.

That's all there is to it. Not quite like having a disk drive, but at least now tape storage will be far less likely to cause you distress.

Atari Verify

```
1 CLR :DIM A$(128):POKE 203,ADR(A$)-
  (INT(ADR(A$)/256)*256):POKE 204,IN
  T(ADR(A$)/256):REM POKE START LOCA
  TION OF A$
2 FOR I=1536 TO 1565:READ A:POKE I,A
  :NEXT I:TRAP 7:REM POKE IN M.L. RO
  UTINE AND SET TRAP FOR END OF FILE
   FLAG
3 ? CHR$(125);"INSERT TAPE TO TEST":
  ? "PRESS ANY KEY TO BEGIN"
4 CLOSE #1:OPEN #1,4,255,"C:":REM CH
  ANGE 255 TO 0 FOR TAPES WITH LONG
  INTER-RECORD GAPS
5 FOR I=1 TO 100000:GET #1,B:X=USR(1
  536):REM LOOP THROUGH THIS MORE TI
  MES THAN ANYONE WILL EVER NEED
6 POKE 203,ADR(A$)-(INT(ADR(A$)/256)
  *256):POKE 204,INT(ADR(A$)/256):NE
  XT I:REM EUREKA!  RESET POINTER TO
   START OF A$
7 IF PEEK(195)=136 THEN CLOSE #1:? C
  HR$(125);"GOOD TAPE":END :REM LOOK
   FOR END OF FILE FLAG
8 ? "ERROR - ";PEEK(195):END :REM TA
  PE IS NOT READABLE
9 DATA 104,174,138,2,134,61,160,0,16
  2,0,185,0,4,129,203,200,230,203,20
  8,2,230,204,196,61,240,3,76,10,6,9
  6
```

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PLOTting On The Apple

Thomas P. Anderson

How to plot and handle the screen on Apple's high resolution screen. Requires 16K RAM. This machine language routine simplifies screen graphics.

This little study of mine, which began about three months ago, first started after I had written a short BASIC program to plot pictures on the high resolution screen with four lines of text at the bottom. The entire screen memory had to be saved to store the picture on the disk. To avoid this waste of space, I decided to find out the memory locations of the four bottom screen lines. I could then devise a method of saving all screen memory except for those four lines.

I quickly found the necessary addresses, but in the process I also noticed how strangely the screen memory was laid out. There had to be a way of decoding the inconsequent order of screen memory, so that a specific point on the screen could be referenced easily.

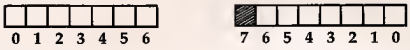
How does Applesoft do it? I found absolutely no documentation of this subject. I could have waded through about 8K of disassembled code and still not found the answer, so I was on my own in figuring this one out. In this article, I am relating to you what I have found out about PLOTting on the high resolution screen in machine language.

Base Addresses

First of all, a review of the hi-res screen layout. The screen has a resolution of 192 lines by 280 dots. The lines are referenced by the decimal values 0-191, and the dots are referenced by the decimal values 0-279. The position of (0,0) is in the upper left-hand corner.

Seven consecutive dots of a line are controlled by the value stored in one byte of memory, so 40 bytes are required to control one line. These 40 bytes, referenced by the decimal values 0-39, I will call the column position. The zero column position is the base address in memory of the line. To see what values are necessary to turn on a dot, we have to look at the bit patterns of the controlling byte.

Screen Column Position **Controlling Memory Byte**



Shown above are seven consecutive dots on the screen and the controlling byte. If bit three of the controlling byte is on, then the dot in position three within the column will be on. Bit seven of the controlling byte will be zero for this article, since I am not concerned here with manipulating the screen colors.

What To Calculate

Once I had reviewed the basics of screen memory, my problem became defined for me. The routines I had to write would take two decimal values: 1) a line number in the range of 0-191, and 2) a dot position in the range of 0-279. From these values the routines would calculate:

1) The 16-bit hexadecimal *base address*,
2) The *column position* in the range of 0-39, and
3) The *dot position within* the *column* in the range of 0-6.

I will explain the calculation of the base address first, since it is the complicated one. To understand this, I had to know what all the possible base addresses of page two could be. I used page two during the testing because PLOTting on page one wrote over my source file in memory, and it had to be reloaded after every test.

All base addresses lie within the range of \$4000-\$7FD0. This means that the high byte of our address will be in the range of \$40-\$7F, and the only possibilities for the low byte are \$00, \$28, \$50, \$A8, or \$D0. To see how this works exactly, I assigned variables to the bit positions of the line number.

Since we know the maximum and minimum value of the base address, we know that certain bits of the base address will always be off or on no matter what the line number is. Shown below are the assigned variables of the line and the starting framework of the base address.

Line Number

A	B	C	D	E	F	G	H
7	6	5	4	3	2	1	0

Base Address

0	1	0	?	?	?	?	?	?	?	?	?	?	0	0	0
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
High Byte								**Low Byte**							

Figuring Bit Positions

The steps that follow are the ones that I used to figure the bit position of the line that would determine the value of a bit position in the base address.

1. Choose a questionable bit position of the base address.

2. Determine all the possible values of that byte if the bit is on.

3. Determine all the possible values of that byte if the bit is off.

4. Determine all the possible values of the line number based on the values found in Step 2.

5. Determine all the possible values of the line number based on the values found in Step 3.

6. By examining the binary values of the line numbers, the bit patterns are easily seen. There will be one bit position in the values from Step 4 that is always the complement of that same bit position in the values from Step 5. Therefore, this bit position of the line number is the determining bit for the questionable bit in Step 1.

Using these steps for all questionable bits of the base address, I ended up with the representation of the base address as shown below.

Base Address

0	1	0	F	G	H	C	D	E	A	B	A	B	0	0	0
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
High Byte								**Low Byte**							

Now that I had figured out the starting and ending representations, I wrote the routine HBASCALC to perform this operation. This routine is shown in Program 1. The routine is entered with the line number in location HCV and exits the routine with the base address in locations HBASL and HBASH. The documentation explains the process and shows how the variable representations are manipulated by each instruction. This routine can be easily changed to use page one by changing the instruction ORA#$40 to ORA#$20 and setting the appropriate soft switches for page one.

That may have been a bit complex; but now that you have the HBASCALC routine, you won't have to follow those steps as I did.

Calculating the column position and the dot position within the column was a simpler task for me. Since there are 280 dots to represent with 40 bytes of memory, I needed to divide the dot position by seven. The quotient would be the column position, and the remainder would be the dot position within the column. At first I used the standard 16-bit by 16-bit division routine, but this process seemed a little slow for PLOTting.

So I tried another routine which simply subtracted seven from the dot position until it went to less than zero. An index register was used to count the number of times seven could be subtracted, which gave me the column position, and then adding seven back to the now negative dot position gave me the dot position within the column.

Being unsure of the speed of this routine, I calculated the time required by each routine to plot 280 positions, one full line, and I found that the second routine used about 120,000 machine cycles less than the standard routine. The faster routine is called DIVIDE and is shown with the demo program (Program 2).

Plotting A Grid

This division process is the most time consuming aspect of hi-res plotting. I learned quickly that if the main driving routine consists of nested loops, as Hi-res Grid Demo does, then the division routine should be used in the outer routine, or the entire routine will be greatly slowed. If the division is performed in the inner loop, it will be executed for every dot plotted. If the division is performed in the outer loop, it will be executed only when the dot position changes.

Program 2, Hi-res Grid Demo, will accept input from the user in the range of 1-9. It then draws the grid with the number input as the number of spaces between each line of the grid. The program PLOTs the grid until it goes off the edge of the screen, and then it goes back and erases the excess plots to make a neater appearing grid. The program will terminate with a CONTROL-C.

Hi-res Grid Demo is fairly simple, but its purpose is to show you the basic routines used in PLOTting with machine language. Perhaps it will stimulate you to look further to other possibilities, such as color PLOTting, line drawing routines, animation, and faster game design than BASIC will allow. I know it has me working on other ideas. As for my original objective, the saving of hi-res pictures without the four bottom lines, I forgot all about that once I discovered the other interesting possibilities at my fingertips.

Program 1: Base Address Calculation

```
* LISTING 1.
*
**********************************************
*HIRES BASE ADDRESS CALCULATION ROUTINE.PAGE 2*
**********************************************
HBASCALC PHA
         LDA   HCV      ;ABCDEFGH; GET VERT. POS.(0-191).
         ASL            ;BCDEFGHO; SHIFT LEFT UNTIL BITS
         ASL            ;CDEFGHOO; "FGH" ARE  IN CORRECT POSITION.
         AND   #$1C     ;000FGHOO; TURN OFF ALL BUT BITS "FGH".
         ORA   #$40     ;010FGHOO; BIT SIX IS ALWAYS ON.
         STA   HBASH    ;010FGHOO; SAVE THIS PORTION.
         LDA   HCV      ;ABCDEFGH; START AGAIN.
         LSR            ;OABCDEFG; SHIFT RIGHT UNTIL THE
         LSR            ;OOABCDEF; "E" BIT SHIFTS TO CARRY.
         LSR            ;OOOABCDE; AND BITS "CD"
         LSR            ;OOOOABCD; ARE IN CORRECT POSITION.
         AND   #3       ;000000CD; TURN OFF ALL BUT "CD" AND
         ORA   HBASH    ;010FGHCD; MERGE TO COMPLETE HI-BYTE
         STA   HBASH    ;010FGHCD;
         LDA   HCV      ;ABCDEFGH; WORK ON LO-BYTE.
         AND   #$C0     ;AB000000; TURN OFF ALL BUT BITS "AB".
         PHA            ;AB000000; SAVE IT.
         ROR            ;EAB00000; GET "E" BIT BACK FROM CARRY.
         STA   HBASL    ;EAB00000; SAVE THIS PORTION.
         PLA            ;AB000000; PULL BACK BITS "AB" AND
         LSR            ;0AB00000; SHIFT RIGHT UNTIL THEY
         LSR            ;00AB0000; ARE IN CORRECT POSITION.
         LSR            ;000AB000;
         ORA   HBASL    ;EABAB000; MERGE TO COMPLETE LO-BYTE.
         STA   HBASL    ;EABAB000;
         PLA
         RTS
```

Program 2: Hi-res Grid Demo

```
* LISTING 2
*
********************
* HIRES GRID DEMO *
* BY TOM ANDERSON *
********************
*
* SYSTEM SOFT SWITCHES
*
KBD      EQU  $CØØØ  ;READ KEYBOARD
KBDSTR   EQU  $CØ1Ø  ;CLEAR KEYBOARD
GRAPHICS EQU  $CØ5Ø  ;GRAPHICS MODE
HIRES    EQU  $CØ57  ;HI-RESOLUTION GRAPHICS
PRIMARY  EQU  $CØ54  ;PAGE ONE
ALLGR    EQU  $CØ52  ;FULL SCREEN GRAPHICS
TXTMODE  EQU  $CØ51  ;TEXT MODE
SECOND   EQU  $CØ55  ;PAGE TWO
*
*PAGE ONE LOCATIONS USED
*
CH       EQU  $24    ;TEXT COLUMN POSITION(Ø-39)
CV       EQU  $25    ;TEXT LINE POSITION(Ø-23)
HCV      EQU  $25    ;HIRES LINE POSITION(Ø-191)
HPOSLO   EQU  $26    ;HIRES DOT POSITION(Ø-279)
HPOSHI   EQU  $27
HBASL    EQU  $28    ;HIRES LINE BASE ADDRESS
HBASH    EQU  $29
REMLO    EQU  $2C    ;REMAINDER IN DIVISION ROUTINE
REMHI    EQU  $2D
GRIDSZ   EQU  $2E    ;VALUE OF GRID SIZE
RTMARG   EQU  $2F
```

```
                    *
                    *MONITOR ROUTINES
                    *
                    COUT     EQU  $FOEO   ;CHARACTER OUTPUT ROUTINE IN MONITOR
                    HOME     EQU  $FC58   ;MONITOR ROUTINE TO CLEAR TEXT PAGE
                    BASIC    EQU  $300    ;VECTOR TO RETURN TO CURRENT BASIC
7000: 20 C2 70      START    JSR  PROISP ;OISPLAY INPUT PROMPT
7003: 20 9B 70               JSR  INPUT  ;GET USER INPUT
7006: 20 4A 71               JSR  INHRES ;INITIALIZE HIRES MOOE
                    ************************
                    * DRAW VERTICAL LINES *
                    ************************
7009: A9 00                  LOA  #0      ;START ANO RESET OOT POSITION TO ZERO
700B: 85 26                  STA  HPOSLO
7000: 85 27                  STA  HPOSHI
700F: A9 00         VERT     LOA  #0      ;START LINE ZERO
7011: 85 25                  STA  HCV
7013: 20 EF 70               JSR  DIVIOE ;CALCULATE HORIZONTAL OFFSET
7016: 20 21 71      VERT1    JSR  HBASCALC ;CALCULATE LINE BASE AOORESS
7019: 20 10 71               JSR  OISPLAY ;TURN ON ONE OOT
701C: E6 25                  INC  HCV     ;LINE=LINE+1
701E: A5 25                  LOA  HCV
7020: C9 C0                  CMP  #192    ;BOTTOM OF SCREEN?
7022: 90 F2                  BCC  VERT1   ;NO, GO BACK
7024: 18                     CLC
7025: A5 26                  LOA  HPOSLO ;OOT POSITION=OOT POSITION+GRIOSZ
7027: 65 2E                  AOC  GRIOSZ
7029: 90 02                  BCC  OVERV
702B: E6 27                  INC  HPOSHI
702D: 85 26         OVERV    STA  HPOSLO
702F: A5 27                  LOA  HPOSHI ;ENO OF LINE?
7031: 4A                     LSR
7032: 90 DB                  BCC  VERT    ;NO, GO BACK
7034: A5 26                  LOA  HPOSLO
7036: C9 18                  CMP  #$18
7038: 90 D5                  BCC  VERT
703A: E5 2E                  SBC  GRIOSZ ;RTMARG=LAST DOT POSITION PLOTTEO
703C: 85 2F                  STA  RTMARG
                    **************************
                    * ORAW HORIZONTAL LINES *
                    **************************
703E: A9 00                  LOA  #0      ;START OOT POSITION ZERO
7040: 85 26                  STA  HPOSLO
7042: 85 27                  STA  HPOSHI
7044: A9 00         HORIZ    LDA  #0      ;START ANO RESET LINE TO ZERO
7046: 85 25                  STA  HCV
7048: 20 EF 70               JSR  OIVIOE ;CALCULATE HORIZONTAL OFFSET
704B: 20 21 71      HORIZ1   JSR  HBASCALC ;CALCULATE LINE BASE AOORESS
704E: 20 10 71               JSR  OISPLAY ;OISPLAY VALUE TO TURN ON ONE DOT
7051: 18                     CLC
7052: A5 25                  LOA  HCV
7054: 65 2E                  AOC  GRIOSZ ;LINE=LINE+GRIOSZ
7056: 85 25                  STA  HCV
7058: C9 C0                  CMP  #192    ;BOTTOM OF SCREEN?
705A: 90 EF                  BCC  HORIZ1 ;NO, GO BACK
705C: E6 26                  INC  HPOSLO ;YES,DOT POS.=OOT POS.+1
705E: 00 02                  BNE  OVERH
7060: E6 27                  INC  HPOSHI
7062: A5 27         OVERH    LOA  HPOSHI
7064: 4A                     LSR
7065: 90 DD                  BCC  HORIZ
7067: A5 26                  LOA  HPOSLO
7069: C5 2F                  CMP  RTMARG ;REACHEO RIGHT MARGIN?
706B: 90 07                  BCC  HORIZ   ;NO, GO BACK
7060: A5 25                  LOA  HCV     ;OETERMINE BOTTOM CUTOFF POINT
706F: E5 2E                  SBC  GRIOSZ
7071: 85 25                  STA  HCV
7073: A9 00                  LDA  #0
```

```
7075: E6 25              INC  HCV
7077: 20 21 71  CLRBTM   JSR  HBASCALC ;CLEAR UNNESSECARY PLOTS AT
707A: A0 28              LDY  #40     ;BOTTOM OF THE SCREEN
707C: 88        NXTBYT   DEY
707D: 91 28              STA  (HBASL),Y
707F: D0 FB              BNE  NXTBYT
7081: E6 25              INC  HCV
7083: A6 25              LDX  HCV
7085: E0 C0              CPX  #192
7087: D0 EE              BNE  CLRBTM
7089: AD 00 C0  RDKEY    LDA  KBD     ;GRID DRAWN, A CONTROL-C AT THIS
708C: 10 FB              BPL  RDKEY   ;POINT WILL TERMINATE
708E: 8D 10 C0           STA  KBDSTR  ;ANY OTHER KEYSTROKE WILL RESTART
7091: C9 83              CMP  #$83
7093: D0 03              BNE  RESTART
7095: 4C A7 70           JMP  EXIT
7098: 4C 00 70  RESTART  JMP  START
                ***************
                * USER INPUT *
                ***************
709B: AD 00 C0  INPUT    LDA  KBD     ;SINGLE KEY INPUT
709E: 10 FB              BPL  INPUT
70A0: 8D 10 C0           STA  KBDSTR
70A3: C9 83              CMP  #$83    ;CONTROL-C WILL TERMINATE
70A5: D0 0C              BNE  DIG     ;NOT CNTRL-C
70A7: 20 58 FC  EXIT     JSR  HOME
70AA: AD 51 C0           LDA  TXTMODE
70AD: AD 54 C0           LDA  PRIMARY
70B0: 4C D0 03           JMP  BASIC
70B3: C9 B1     DIG      CMP  #$B1    ;IS IT < 1?
70B5: 90 E4              BCC  INPUT   ;YES,INVALID GO BACK
70B7: C9 BA              CMP  #$BA    ;IS IT > 9?
70B9: B0 E0              BCS  INPUT   ;YES,INVALID GO BACK
70BB: 29 0F              AND  #$0F    ;MASK OFF 4 MSB'S
70BD: 69 01              ADC  #1
70BF: 85 2E              STA  GRIDSZ  ;THIS IS SIZE OF GRID
70C1: 60                 RTS
                **************************
                * DISPLAY INPUT PROMPT *
                **************************
70C2: AD 51 C0  PRDISP   LDA  TXTMODE ;SET SWITCHES FOR TEXT MODE PAGE ONE
70C5: AD 54 C0           LDA  PRIMARY
70C8: 20 58 FC           JSR  HOME    ;CLEAR SCREEN
70CB: A9 0C              LDA  #12     ;SET DISPLAY FOR HTAB 10,VTAB 12
70CD: 85 25              STA  CV
70CF: A9 0A              LDA  #10
70D1: 85 24              STA  CH
70D3: A2 0F              LDX  #15
70D5: BD DF 70  NXTCHR   LDA  PROMPT,X ;GET CHARACTER
70D8: 20 ED FD           JSR  COUT    ;DISPLAY
70DB: CA                 DEX
70DC: D0 F7              BNE  NXTCHR
70DE: 60                 RTS
70DF: A0 BF A0  PROMPT   ASC  "     ? )9-1(EZISDIRG"
                *********************************
                *DIVIDE DOT POSITION BY SEVEN *
                *********************************
70EF: A5 26     DIVIDE   LDA  HPOSLO
70F1: 85 2C              STA  REMLO
70F3: A5 27              LDA  HPOSHI
70F5: 85 2D              STA  REMHI
70F7: 38                 SEC
70F8: A0 FF              LDY  #$FF
70FA: C8        DIV1     INY
70FB: A5 2C              LDA  REMLO
70FD: E9 07              SBC  #7
70FF: 85 2C              STA  REMLO
7101: A5 2D              LDA  REMHI
```

```
7103: E9 00              SBC  #0
7105: 85 2D              STA  REMHI
7107: 10 F1              BPL  DIV1
7109: A5 2C              LDA  REMLO
710B: 69 07              ADC  #7
710D: 85 2C              STA  REMLO
710F: 60                 RTS
               *******************
               * DISPLAY ROUTINE *
               *******************
7110: A6 2C    DISPLAY   LDX  REMLO  ;DOT POSITION WITHIN COLUMN(0-6)
7112: BD 1A 71           LDA  ONBIT,X ;GET VALUE TO TURN BIT ON
7115: 11 28              ORA  (HBASL),Y ;MERGE WITH VALUE ALREADY THERE
7117: 91 28              STA  (HBASL),Y ;DISPLAY NEW VALUE
7119: 60                 RTS
711A: 01 02 04 ONBIT     HEX  01020408102040
               ********************************************
               *HIRES BASE ADDRESS CALCULATION ROUTINE,PAGE 2*
               ********************************************
7121: 48       HBASCALC PHA
7122: A5 25              LDA  HCV
7124: 0A                 ASL
7125: 0A                 ASL
7126: 29 1C              AND  #$1C
7128: 09 40              ORA  #$40
712A: 85 29              STA  HBASH
712C: A5 25              LDA  HCV
712E: 4A                 LSR
712F: 4A                 LSR
7130: 4A                 LSR
7131: 4A                 LSR
7132: 29 03              AND  #3
7134: 05 29              ORA  HBASH
7136: 85 29              STA  HBASH
7138: A5 25              LDA  HCV
713A: 29 C0              AND  #$C0
713C: 48                 PHA
713D: 6A                 ROR
713E: 85 28              STA  HBASL
7140: 68                 PLA
7142: 4A                 LSR
7143: 4A                 LSR
7144: 05 28              ORA  HBASL
7146: 85 28              STA  HBASL
7148: 68                 PLA
7149: 60                 RTS
               *************************
               * CLEAR HIRES PAGE TWO *
               *************************
714A: A9 00    INHRES    LDA  #0      ;START LINE ZERO
714C: 85 25              STA  HCV
714E: 20 21 71 SCREEN    JSR  HBASCALC ;NEW BASE ADDR. WHEN HCV CHANGES
7151: A0 28              LDY  #40     ;NUMBER OF COLUMNS
7153: 88       LINE      DEY          ;COLUMN=COLUMN-1
7154: 91 28              STA  (HBASL),Y ;DISPLAY VALUE ZERO
7156: D0 FB              BNE  LINE    ;COLUMN=ZERO?
7158: E6 25              INC  HCV     ;YES, LINE=LINE+1
715A: A6 25              LDX  HCV
715C: E0 C0              CPX  #192    ;LAST LINE CLEARED?
715E: D0 EE              BNE  SCREEN ;NO, GO BACK
               ********************************
               * SET SOFT SWITCHES FOR HIRES *
               ********************************
7160: AD 57 C0           LDA  HIRES
7163: AD 50 C0           LDA  GRAPHICS
7166: AD 55 C0           LDA  SECOND
7169: AD 52 C0           LDA  ALLGR
716C: 60                 RTS
```

COMPUTE's Author Guide

Most of the following suggestions serve to improve the speed and accuracy of publication. **COMPUTE!** is primarily interested in new and timely articles on VIC, Apple, PET/CBM, Commodore 64, Atari, Timex/Sinclair, TI/99-4A, and Radio Shack Color Computer. We are much more concerned with the content of an article than with its style. Above all, articles should be clear and well-explained.

The guidelines below will permit your good ideas and programs to be more easily edited and published:

1. The upper left corner of the first page should contain your name, address, telephone number, and the date of submission.

2. The following information should appear in the upper right corner of the first page. If your article is specifically directed to one make of computer, please state the brand name and, if applicable, the BASIC or ROM or DOS version(s) involved. In addition, *please indicate the memory requirements of programs.*

3. The underlined title of the article should start about 2/3 of the way down the first page.

4. Following pages should be typed normally, except that in the upper right corner there should be an abbreviation of the title, your last name, and the page number. For example: Memory Map/Smith/2.

5. All lines within the text of the article must be double- or triple-spaced. A one-inch margin should be left at the right, left, top, and bottom of each page. No words should be divided at the ends of lines. And please do not justify. Leave the lines ragged.

6. Standard typing paper should be used (no erasable, onionskin, or other thin paper) and typing should be on one side of the paper only (upper- and lowercase).

7. Sheets should be attached together with a paper clip. Staples should not be used.

8. If you are submitting more than one article, send each one in a separate mailer with its own tape or disk.

9. Short programs (under 20 lines) can easily be included within the text. Longer programs should be separate listings. *It is essential that we have a copy of the program, recorded twice, on a tape or disk.* Please use high quality 10 or 30 minute tapes with the program recorded on both sides. The tape or disk should be labeled with the author's name, the title of the article, and, if applicable, the BASIC/ROM/DOS version(s). Atari tapes should specify whether they are to be LOADed or ENTERed. We prefer to receive Apple programs on disk rather than tape. On the other hand, tapes are preferred for the Radio Shack computer. Tapes are fairly sturdy, but disks need to be enclosed within plastic or cardboard mailers (available at photography, stationery, or computer supply stores).

It is far easier for others to type in your program if you use CHR$(X) values and TAB(X) or SPC(X) instead of cursor manipulations to format your output. For five carriage returns, FOR I = 1 TO 5:PRINT:NEXT is far more "portable" to other computers with other BASICs and also easier to type in. And, instead of a dozen right-cursor symbols, why not simply use PRINT SPC(12)? A quick check through your program – making these substitutions – would be greatly appreciated by your editors and by your readers.

10. A good general rule is to spell out the numbers zero through ten in your article and write higher numbers as numerals (1024). The exceptions to this are: Figure 5, Table 3, TAB(4), etc. Within ordinary text, however, the zero through ten should appear as words, not numbers. Also, symbols and abbreviations should not be used within text: use "and" (not &), "reference" (not ref.), "through" (not thru).

11. For greater clarity, use all capitals when referring to keys (RETURN, TAB, ESC, SHIFT), BASIC words (LIST, RND, GOTO), and three languages (BASIC, APL, PILOT). Headlines and subheads should, however, be initial caps only, and emphasized words are not capitalized. If you wish to emphasize, underline the word and it will be italicized during typesetting.

12. Articles can be of any length – from a single-line routine to a multi-issue series. The average article is about four to eight double-spaced, typed pages.

13. If you want to include photographs, they should be either 5x7, black and white glossies or color slides.

14. We do not consider articles which are submitted simultaneously to other publishers. If you wish to send an article to another magazine for consideration, please do not submit it to us.

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16. If your article is accepted and you have since made improvements to the program, please submit an entirely new tape or disk and a new copy of the article reflecting the update. We cannot easily make revisions to programs and articles. It is necessary that you send the revised version as if it were a new submission entirely, but be sure to indicate that your submission is a revised version by writing "Revision" on the envelope and the article.

17. COMPUTE! does not accept unsolicited product reviews. If you are interested in serving on our panel of reviewers, contact the Review Coordinator for details.

Relocating VIC Loads

Tony Valeri

When you need to relocate a program in the VIC's memory, you can use this simple technique.

As most VIC users know, the VIC relocates all programs to the start of BASIC memory unless told otherwise. For example, LOAD 1,1 tells the computer to load the program into the area of memory specified by the tape.

So we have two choices; we can either load a program into the start of BASIC memory (usually $1000 hex) or load a program back into its original location in memory (using a monitor like TINYMON). But what if we want to place a previously prepared subroutine at the end of a program, or relocate a machine language program to some novel place in memory? There's not much we could do short of retyping it.

Basically, what happens during a LOAD is that, after a few pointers are stored (buffer location, program name, etc.), a routine is called that searches the tape for the next program header, and then reads it into the cassette buffer. The load routine next checks the buffer to find out whether the program being loaded is to be placed into the locations specified in the buffer or is to be relocated to the start of BASIC. Now, if we could by-pass the routine that does this, things would be much simpler.

In the figure, you'll see the locations necessary to relocate a program *anywhere* in the VIC's memory.

Use a SYS 63407. The computer will prompt with the usual PRESS PLAY ON TAPE. The difference is that the computer now prints READY as soon as the program is found. What has happened is that the SYS 63407 tells the computer to load the next program header and store the information in the cassette buffer.

To find out the original start and end locations of your program, type in PRINT PEEK(829) + PEEK(830)*256, PEEK(831) + 256*PEEK(832).

Increasing the value in locations 829 and 831 by one will place the program one byte higher in memory. Increasing the value in locations 830 and 832 by one will place the program 256 bytes higher in memory. Decreasing the values in these locations will have the opposite effect.

After the buffer has been changed, a SYS 62980 will return control of the computer to the load routine. Now load the main body of the program into memory, but load it into the *new* locations just specified.

See It Work

To demonstrate this technique, we'll fill the screen with data from tape. The demonstration is for the unexpanded VIC, so you'll need to remove or disable any memory expansion. To prepare, type in the following line in direct mode:

```
POKE 46,PEEK(46) + 2
```

This reserves two pages (512 bytes) at the end of your BASIC program for data.

Type in the following one-line program *exactly* as it appears. Any additional spaces will cause errors. The program will fill the space between the end of the program and the start of variables with the screen POKE value for the ball character.

```
10 FORA=4124TO4629:POKEA,81:NEXT
```

After checking your typing, RUN the program then SAVE it to cassette.

Next, rewind the tape and reset the VIC with a SYS 64802. Start the relocatable load by typing:

```
SYS 63407
```

After the VIC reads the tape header into its buffer you can check the original start and end addresses by PEEKing addresses 829 - 832 as indicated above. The starting and ending addresses should be 4097

	HEX	DEC
Routine To Load Header	$F7AF	63407
Buffer Start Of Prog.	$033D & $033E	829 & 830
Buffer End Of Prog.	$033F & $0340	831 & 832
Continue Load	$F607	62980

Locations necessary to place a program anywhere in the VIC's memory.

and 4636. Instead we want to put the block of 506 ball characters into screen memory, which starts at location 7680. To accomplish this, type in the following series of POKEs:

```
POKE 829,229:POKE 830,29:POKE 831,0:POKE 832,32
```

You'll need to prepare the screen by changing the colors to make the balls visible. Try POKE 36879,76. Finally, complete the tape LOAD by typing:

```
SYS 62980
```

The data coming in from tape will be directed to the screen memory area and will fill the display with ball characters. ©

Commodore 64 Video – A Guided Tour

Jim Butterfield, Associate Editor

In this, the final installment of our exploration of the Commodore 64's unique video design, we look at a solution to the pesky "hiccup" screen glitch.

Last time, we looked at a simple program to split the screen of the Commodore 64. It was similar, but not identical, to this one:

```
100 FOR J=828 TO 862:READ X
110 T=T+X:POKE J,X
120 NEXT J
130 IF T<>3929 THEN STOP
200 DATA 173,25,208,41,1,240,25,141,25,2
    08,162,146,160,6,173,18
210 DATA 208,16,4,162,1,160,0,142,18,208
    ,140,33,208,76,188,254,76,49,234
300 POKE 56333,127
310 POKE 788,60:POKE 789,3
320 POKE 56333,129:POKE 53274,129
```

Our previous example split the screen into two sections: graphics and text. This one splits the screen into two background color areas. It makes it easier for us to see the glitch – the hiccup that occasionally disturbs our screen split. By the way, it's easier to see the problem when you are using the keyboard.

Why The Problem?

Here's where the problem comes from: the timer interrupt strikes about every 1/60 of a second. The screen display, too, runs at a rate of about 60 times a second. But they are not synchronized. The two processes run at similar, but not identical, speeds.

Now, every once in a while, the timer interrupt hits just before the raster interrupt. The timer interrupt has quite a few jobs to do: update the TI$ clock, check the cassette motor, flash the cursor, and check the keyboard. It takes time to do these jobs, and extra time is required if a key is being pressed.

Suppose we have just started on the timer interrupt, and the raster scan says, "I'm ready!" Sorry, raster, we're already into an interrupt routine, and other interrupts are locked out until we have finished. By that time, the screen scan might have moved along a few lines, and our split screen has crept from its normal position.

Some Possible Fixes

There are several possible approaches to fixing this jitter. The ones that come to mind first are complex; in a moment, we'll move on to an easy one.

When the timer interrupt strikes, we could ask it to look at the raster and see if the scan was close to the interrupt point. If so, we might wait things out, or skip part of the timer interrupt jobs. Messy.

The timer interrupt could "unlock" the interrupt very quickly, using a CLI command. That way, we could interrupt the interrupt program itself to do the split screen job. Better, but some programmers feel it's dangerous to allow this kind of thing to happen.

A Better Way

There is an easier way: shut the timer interrupt off completely, and do its various jobs with our own programs. This *seems* complex, but it's not. We can call the timer interrupt routines ourselves, whenever it's time.

Let's look a little more closely into the timing of these interrupts. We expect to cause a raster scan interrupt about 120 times a second. That's twice as often as the timer interrupt needs to be handled. So our raster program could occasionally call in the timer interrupt program.

It seems that we could accomplish the task easily by calling the timer interrupt routines every second raster interrupt. That would certainly do the job, but there's a better way.

Even though we've shut off the timer inter-

Table 1:

6566 Video Chip
C64 Control and Miscellaneous Registers

D011		Extended Color Mode	Bit Map	Display Enable	Row Select	Y-Scroll			53265
D012	Raster Register								53266
D013	Light Pen Input X								53267
D014	Light Pen Input Y								53268
D016	X	X	Reset	Multi Color	Col Select	X-Scroll			53270
D018	Screen VM13	VM12	VM11	VM10	Character Base CB13	CB12	CB11	X	53272
D019	IRQ	Interrupt ← Sense →			LP	SSC	SBC	RST	53273
D01A	Interrupt Enable →				Light Pen	Sprite Collision with Sprite	Back	Raster	53274

Color Registers

D020	X	Exterior	53280
D021	X	Background #0	53281
D022	X	Background #1	53282
D023	X	Background #2	53283
D024	X	Background #3	53284
D025	X	Sprite Multicolor #0	53285
D026	X	Sprite Multicolor #1	53286

Table 2:

6566 Video Chip
C64 Sprite Registers

Sprite 0	Sprite 7			Sprite 0	Sprite 7
D000	D00E	Position	X	53248	53262
D001	D00F	Position	Y	53249	53263
D027	D02E	X	Color	53287	53294

Sprite

	7	6	5	4	3	2	1	0	
D010	X-Position High								53264
D015	Sprite Enable								53269
D017	Y-Expand								53271
D01B	Background Priority								53275
D01C	Multicolor								53276
D01D	X-Expand								53277
D01E	Interrupt: Sprite Collision								53278
D01F	Interrupt: Background Collision								53279

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rupt, it's still signaling when the time is ready. Let's review: the timer leaves a signal in hex address $DC0D (56333) whenever it counts down to zero. Normally, this signal triggers the interrupt line (IRQ) and causes the processor to be interrupted. But we may "break" the connection between the timer signal and the interrupt line. In this case, the timer will not cause an interrupt, but the signal bit will still flash when the appropriate time has come.

We can see the plan in Figures 1 and 2. We will disconnect the timer from interrupt, and service it ourselves when it flashes. Easier done than said. Let's look at the machine language coding:

```
033C A9 01     INTR  LDA #$01
033E 8D 19 D0        STA $D019
```

Raster interrupt is now the only game in town, so we don't need to test for it. We must, of course, turn off the raster interrupt flag.

```
0341 A2 92           LDX  #$92
0343 A0 06           LDY  #$06
```

Setup for top of screen. Next interrupt, line 92 hex; new color, number 6.

```
0345 AD 12 D0        LDA  $D012
0348 10 04           BPL  MID
```

If it's really the top of screen, we can skip ahead. Otherwise, we change for mid-screen – line 1, new color, number 0:

```
034A A2 01           LDX  #$01
034C A0 00           LDY  #$00
```

Now we're ready to do the job, wherever the screen is:

```
034E 8E 12 D0  MID   STX  $D012
0351 8C 21 D0        STY  $D021
```

The job is done. Now let's see if the timer interrupt is calling for action:

```
0354 AD 0D DC        LDA  $DC0D
0357 29 01           AND  #$01
0359 F0 03           BEQ  SKIP
```

If we didn't skip, the timer wants attention. Call it in:

```
035B 4C 31 EA        JMP  $EA31
```

If we did skip, the timer isn't needed. Quit with:

```
035E 4C BC FE  SKIP  JMP  $FEBC
```

We must remember, of course, to: turn off the timer interrupt; set the IRQ vector to our new code; and turn on the raster interrupt. We'll do all that in BASIC. Speaking of which....

BASIC-ally Yours

Here's the same program in BASIC.

```
100 FOR J=828 TO 864:READ X
110 T=T+X:POKE J,X
120 NEXT J
130 IF T<>4077 THEN STOP
200 DATA 169,1,141,25,208,162,146,160,6,
    173,18,208,16,4,162,1
210 DATA 160,0,142,18,208,140,33,208,173
    ,13,220
220 DATA 41,1,240,3,76,49,234,76,188,254
300 POKE 56333,127
310 POKE 788,60:POKE 789,3
320 POKE 53274,129
```

Now we have a rock-solid color change at the appropriate screen point. No creeping, no jittering, no hiccups.

We've only touched upon the techniques of raster interrupt. A whole host of new possibilities open up with its use.

But we've shown it can be done, and some of the techniques that can be used to do it.

Figure 1:

"Conventional" coding requires the program to distinguish between the two live timing sources. It may also cause timing jitter.

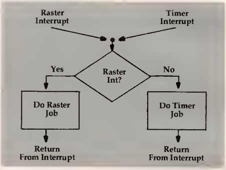
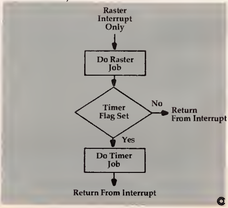


Figure 2:

Single interrupt coding gives priority to the time-sensitive raster job.



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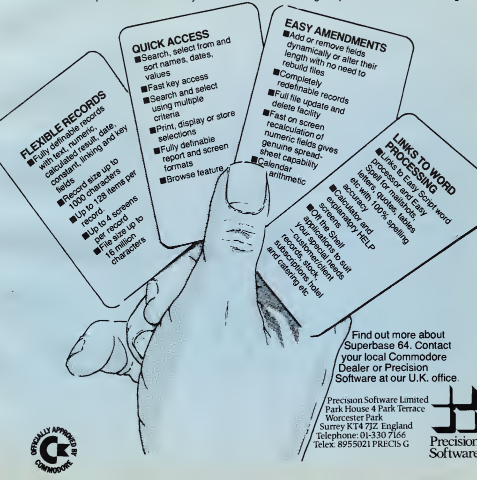

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Troubleshooting A Program

John Blackford, Assistant Features Editor

Suppose you've typed a program into your computer from the pages of **COMPUTE!**, *and it doesn't run. The following checklist should help you find the problem in a jiffy.*

There are two likely sources of trouble in a typed program: typing errors made as you enter the program into your computer or mistakes involving *COMPUTE!'s conventions* – the symbols used to indicate special keystroke combinations. If you have successfully typed in programs from the magazine before, the problem is probably a typing error. But if this is your first try (or if you are working with a new computer which is unfamiliar to you), you may be having trouble with the listing conventions.

Knowing How To Enter The Program

First take a look at the articles published each month, "How To Type COMPUTE!'s Programs," and "A Beginner's Guide To Typing In Programs." As you'll see, finding a character or word enclosed in braces is either a *function key* – such as the "CLEAR" key – or a normal key pressed simultaneously with a *control* or *escape* key. *Don't* type in either the letters of the word in braces, or the braces themselves. Instead, press the key or keys indicated by the words within braces. {CLEAR} means, press the CLR key.

What about the possibility that the program in the magazine is incorrect? Each program we publish is tested carefully, and the versions for each different computer brand are checked separately. When we have a given version running smoothly, we LIST the program directly onto paper. This paper version is photocopied and then appears as is in the magazine. Because of this, there is very little chance of a typographical error in the magazine version – it is identical to the program that was pretested in the computer.

Still, we *have* made mistakes. In almost every case, though, a program *will* run correctly as printed. If you continue to have problems after having followed these troubleshooting procedures, check the section of the magazine called CAPUTE! the next issue or two following the program in question.

On the other hand, there is a good chance that a typing error crept in as you keyed the program listing into your computer. The result can be anything from a slightly quirky display (such as square trees) to no game at all – just a cryptic error message or even a lock-up. When a computer *locks up*, the keyboard and RESET keys have no effect. To regain control, you must turn off the computer. Everything you typed in is lost. To avoid this disaster, always SAVE your program before you try to RUN it.

Finding The Source Of A Problem

Often, you can trace a mistake by knowing how to interpret error messages. Some computers give you a statement such as "OUT OF DATA," while others give only an error number. If you get a number, look it up in your user's manual. The error statement or number is accompanied by a line number, which helps in locating the problem.

First, LIST the line and make sure that it is exactly the same as the one in the magazine. If it isn't, make the required changes and try to RUN the program again.

Sometimes, the actual error is not on the line named as the source of the problem. If a DATA entry is missing, the error is listed at the line containing the READ instructions. If a string is incorrectly DIMensioned, the error will occur in the line that first calls for the variable, not in the line containing the DIM statement.

Likewise, if you forget to use RETURN to end a subroutine or tell the program to jump to a nonexistent line, the error message will refer to where the computer failed to carry out your instructions, not to where the mistake actually is located. Thus, interpreting this kind of error message requires some imagination, but at least the messages narrow your search to two areas.

If you go through the above steps and still don't find a mistake, you'll have to check the program line by line to be certain that each character is exactly the same as the original text. First, check the line numbers themselves, comparing number by number. Make sure none are missing and that there are no extra ones which never appeared in the magazine.

Now, check the program line by line. As you go, recheck the line numbers. A common mistake is to enter correct information on the wrong line, and it is very easy to miss this when checking because your eye tends to jump from what you read on the screen to the same thing on the page. You may not notice when a program line is matched up with the wrong line number.

Look For Omissions

Another common problem is skipping part of a line or repeating part. A small omission of this sort can produce dramatic results. In the following example, leaving out part of the line creates an "endless loop" that will stop the program in its tracks:

```
10 X=0
20 X=X+1
30 PRINT X
40 GOTO 20
```

This program will never get beyond line 40. Line 20 should have read:

```
20 X=X+1: IF X>10 THEN GOTO 50
```

The second part of line 20 allows the program to get out of the loop. Keep on the lookout for such omissions when you compare the listing line by line.

Once you have cleared up the major problems that keep the program from running at all, you can fine tune any glitches in the display. These can be tedious, but at least you have something to work with and can see right on the screen how your changes are affecting the program.

Troubleshooting can be frustrating. But when you check things out step by step – starting with the most likely sources of trouble – you will reduce your "debugging" time dramatically. ©

COMPUTE! Books

C Regena

DATA, READ, And RESTORE Statements

Let's look at DATA and READ – what do these statements do and how do you use them? Using DATA statements in a program can save memory and may be more efficient than using many equivalent lines of code. However, a DATA statement can be more difficult to decode or understand because it can look like just a random group of numbers.

DATA statements are used in conjunction with READ statements. Together they assign numbers or strings to variable names.

```
100 READ N
110 DATA 5      is equivalent to      100 N=5
```

The DATA-READ concept becomes efficient when you assign several values to a variable name for a particular procedure. Let's look at an example:

```
100 READ A
110 PRINT A,A*A
120 IF A=7 THEN 140 ELSE 100
130 DATA 3,2,6,8,7
140 END
```

When the program comes to READ A, the computer looks for the first DATA statement and assigns the first value, 3, to the variable A. The program continues, then comes to the statement READ A again. The computer has already read the first number, so it assigns the very next number, 2, to A. The process continues. Each time a READ statement is encountered, the *very next* data item in the DATA list is read, whether it is in the same DATA statement or the next DATA statement.

DATA Varieties

DATA statements may be placed anywhere in the program. They are ignored until a READ statement is executed. A "marker" is remembered by the computer so it knows exactly which data item has most recently been READ – and therefore which item the next READ statement will act upon.

A DATA statement may contain one item only or several items separated by commas. Data items may be numeric constants (numbers) or strings. Numbers may be positive or negative and may contain a decimal. Numbers may not be variable names and may not contain operators (such as 5/3). String variables do not need to be in quote marks unless there are leading spaces, trailing spaces, or embedded commas as part of the string. You may specify a null string by " ", or ,, in a series. Example:

```
300 DATA " ",JOHN,,,JIM," "
```

Line 300 contains six data items – null, JOHN, null, null, JIM, and null.

You may combine numbers and strings in the same DATA statements, but you must be careful that the data items in order match the READ statements. If the READ statement specifies a numeric variable, a string will not be accepted. You must have at least as many data items as the READ statements will try to access (or you will get an OUT OF DATA error). If you happen to have extra data items, they will be ignored.

A READ statement may specify one or several items. The items may be a combination of numeric and string variables. Keep in mind that READ statements only read the data and assign values to variables – later program lines would actually print, calculate, sort, or manipulate the data.

Following are some examples:

String Variables

```
100 FOR C=1 TO 5
110 READ A$
120 PRINT A$
130 NEXT C
140 DATA ED,BILL,JOHN,JIM,KELLY
150 END
```

Subscripted Numeric Variables

```
200 FOR I=1 TO 4
210 READ A(I)
220 PRINT "A(";I;")=";A(I)
230 NEXT I
240 DATA 32,-42,48,69,-73,89
250 END
```

Multiple Variables

```
300 FOR I=1 TO 3
310 READ A,B,C
```

```
320 CALL HCHAR(A,B,C)
330 NEXT I
340 DATA 12,24,42,8,8
350 DATA 35,20,15,38
360 END
```

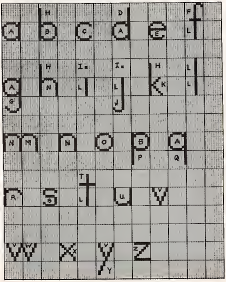
To help conserve memory, a DATA statement can be up to four screen lines long (112 characters). You can edit and insert to make the line even longer. One exception is that if you have quite a few items separated by a lot of commas, the computer will accept only a little over three lines.

Printing Lowercase As An Example

The following program illustrates how DATA and READ statements are used to save memory in defining graphics characters. To specify each character number and definition in a separate CALL CHAR statement would require 26 statements. Using DATA and READ, four lines READ and define the graphics characters, and five data lines are used.

Program 1 redefines the small capital letters in characters 97 through 122 to graphics characters which can print actual lowercase letters. Letters with ascenders or descenders will require two letters to be printed. The chart shows which small capital letter (release the alpha lock key to print these) represents which graphic character. Lines 200-300 in the program illustrate how to print the lowercase letters.

Small Capital Letters And The Graphics Characters They Represent.



Program 1: Lowercase Letters

```
100 CALL CLEAR
110 FOR C=97 TO 122
120 READ C$
130 CALL CHAR(C,C$)
140 NEXT C
150 DATA 3D4381818181433D,BCC2818181
    81C2BC,3C42808080804 23C,00000101
    01010101,3C4281FF8080423C
160 DATA 060908080808083E,0101010141
    221C,0000080808080808,00000008,08
    08080808887,8890A0C0A0908884
170 DATA 0808080808080808,7884020202
    020202,BCC2818181818181.3C428181
    8181423C,8080808080808,01010101010 1
180 DATA BCC2818080808080,3C42403C020
    2423C,000008080087F08.818181818
    181433D.4141222214140808.0404888
    85050202
190 DATA 8244281028448282,1010202040
    4,7F0204081020407F
200 PRINT TAB(4);"1"
210 PRINT TAB(4);"1 o vw e r
    {3 SPACES}c a s e"
220 PRINT :TAB(9);"1{3 SPACES}h
    {3 SPACES}h{3 SPACES}t"
230 PRINT TAB(7);"a 1 b n a b e 1"
240 PRINT TAB(11);"p"
250 PRINT :::"  h{3 SPACES}d
    {3 SPACES}f{3 SPACES}h ı ı h 1"
260 PRINT "a b c a e 1 a n 1 1 k 1 n
    m"
270 PRINT TAB(13);"g{5 SPACES}j"
280 PRINT :TAB(13);"t"
290 PRINT "n o b a r s 1 u v vw x v
    z"
300 PRINT TAB(5);"p q";TAB(24);"y"
310 GOTO 310
320 END
```

RESTOREing

Now let's say you want to use a DATA statement to list some numbers. First you want to add the numbers, and then you want to multiply the numbers. The list of numbers for both processes is the same. To save memory (and typing effort), the TI allows you to RESTORE data. The RESTORE statement indicates that for the very next READ statement the computer will go back to the first DATA item in the program. RESTORE *resets* that "marker" to zero.

```
100 FOR I=1 TO 5
110 READ M,N
120 PRINT M;"+";N;"=";M+N
130 NEXT I
140 PRINT
150 DATA 3,2,5,7,4,4,2,1,9,7
160 RESTORE
170 FOR I=1 TO 5
180 READ A,B
190 PRINT A;"*";B;"=";A*B
200 NEXT I
210 END
```

RUN this sample program to see how the data items are used, then RESTOREd, then used again.

RESTORE can be very useful. TI BASIC also allows you to RESTORE to *a certain line of data* by specifying a line number. If you have a long program with lots of DATA statements, you can use a RESTORE *n* where *n* is a line number to make sure that each READ statement will read the correct data starting with the specified line of data.

This sample program illustrates the use of the RESTORE command. The DATA statements here contain duration factors and frequencies to be used in CALL SOUND statements. Ordinarily the first READ statement would read the first data items from the very first DATA statements. However, line 130 says to start reading the data in line 260 with the very next READ statement. Ten sounds are played; then we RESTORE 260 again so the ten sounds are repeated. Line 190 says RESTORE 240 so the data will start with line 240 for the very next READ statement.

Program 2: Sounds

```
100 CALL CLEAR
110 PRINT "SOUNDS"
120 FOR A=1 TO 2
130 RESTORE 260
140 FOR I=1 TO 10
150 READ T,F
160 CALL SOUND(T*50,F,2)
170 NEXT I
180 NEXT A
190 RESTORE 240
200 FOR I=1 TO 22
210 READ T,F
220 CALL SOUND(T*100,F,2)
230 NEXT I
240 DATA 2,1046,2,784,2,659,4,523,2,
    440
250 DATA 2,392,2,349,3,392,2,330,4,2
    62
260 DATA 6,330,4,262,4,330,6,392,4,5
    23,4,494,6,523
270 DATA 4,392,4,330,6,392
280 DATA 4,330,8,262
290 END
```

This "Southern States" program illustrates a variety of uses of DATA and READ statements. Keep in mind that the DATA statements can go anywhere in the program and are ignored until a READ statement is executed.

Note: As you are typing in programs from listings, the most likely place for *bugs* (errors) is in DATA statements. Be sure you copy DATA statements carefully. Watch particularly the placement of commas. Do not accidentally put a comma at the end of a DATA statement. If your data list consists of graphics definitions, those rounded characters are zeros, not the letter O. If your program stops with a BAD VALUE message, you can PRINT some of the variable names to see if you can pinpoint which DATA statement may be causing an error.

In any case, Southern States is an educational program that draws a map of the United States. One of the Southern States is outlined, and the user must type the name of the state. If the state is correct, the user must then type the name of the capital city. States are chosen in a random order. If you get the state and the capital right, that state will not appear again. However, if you miss an answer twice, the correct answer will be given and the state will appear again.

The data in lines 270-310 defines graphics characters for the map. We're using small capital letters so they can be printed, a faster method of drawing than using CALL HCHAR or CALL VCHAR. Be sure to release the alpha lock key to type in lines 320 and 480-510.

Line 330 (RESTORE 370) is not necessary the first time through the program because the data in line 370 would be the next data anyway. However, the program branches back to line 330 to RESTORE data if you'd like to try a "new" quiz. Lines 340-390 read the names of the states and the capital cities as the S$ array and C$ array.

Outlining States

Lines 540-560 randomly choose one of the states that has not previously been chosen and identified. The S$ value is set to " " (null) if the state is identified correctly. Depending on which state is chosen, certain data is RESTOREd (line 570 then lines 1500-2070).

Each state's data contains first a number representing the number of graphics characters that need to be defined. This number is READ in line 590 (READ N). Lines 600-630 then read the next data items to define the graphics characters. Line 640 reads N, the number of graphics characters that need to be placed on the map, and then lines 650-680 read the row coordinate, column coordinate, and character number from data to outline the state. To erase the state, line 1250 reads N, the number of characters needed to erase the state, and lines 1260-1290 read from the data the row coordinate, column coordinate, erasing graphic character, and number of repetitions. Most of the clearing is done with character 96, the plain yellow square, so repetitions can be used.

Program 3 Explained

Lines	
110	Clear screen.
120-170	Define colors for graphics.
180-210	Print title screen.
230-310	Define graphics characters for map.
320	Define L$ for use in printing the map.
330-390	Read names of states in S$ array and corresponding capital cities in C$ array.
400-460	Print instruction screen and wait for user to press ENTER.
470-510	Clear screen and print map of United States.
520	Perform quiz for 11 states.
530	Initialize T, which keeps track of errors.

540-560	Randomly choose a state which has not previously been identified correctly.
570	Depending on state chosen, branch to appropriate RESTORE statement.
580	Clear four lines under map where answers will be typed.
590-630	Define graphics characters for particular state.
640-680	Outline state on map.
690-710	Ask for state.
720	Clear previous answer if incorrect.
730-810	Receive user's answer.
820-830	Beep then test answer
840-940	If answer is incorrect, sound "uh-oh" and return for another answer. If answer is incorrect twice, print correct answer, wait for user to press ENTER.
950	If answer is correct, play arpeggio.
960-1230	Similar to state, ask for capital city, receive answer, test answer, branch appropriately.
1240	If state and capital are correct, S$(R) is set equal to null, "", so the state will not be chosen again.
1250-1290	Erase the state.
1300	Return for next state to be identified.
1310	Clear printing.
1320-1370	Print option to try again and branch appropriately.
1380-1440	Subroutine to print "PRESS ENTER" and wait for user to press ENTER.
1450-1490	Subroutine to play music for correct answer
1500-1560	RESTORE data for Texas
1570-1620	RESTORE data for Oklahoma.
1630-2060	RESTORE data for Arkansas, Louisiana, Tennessee, Mississippi, Alabama, Florida, Georgia, South Carolina, and North Carolina.
2070	END.

If you prefer to save typing effort, you may receive a copy of Program 3 by sending $3, a blank cassette or diskette, and a stamped, self-addressed mailer to C. Regena, P.O. Box 1502, Cedar City, UT 84720. Be sure to specify "Southern States" for the TI-99/4A computer.

Program 3: Southern States

```
100 REM  SOUTHERN STATES
110 CALL CLEAR
120 FOR G=9 TO 12
130 CALL COLOR(G,12,1)
140 NEXT G
150 CALL COLOR(13,1,12)
160 CALL COLOR(14,1,12)
170 CALL COLOR(15,2,11)
180 PRINT "  ***********************
    ":"  *";TAB(25);"*"
190 PRINT "  * IDENTIFY THE STATES *
    ":"  *";TAB(25);"*"
200 PRINT "  ***********************
    "
210 PRINT :::TAB(7);"SOUTHERN STATES
    "
230 FOR G=96 TO 123
240 READ G$
250 CALL CHAR(G,G$)
260 NEXT G
270 DATA FFFFFFFFFFFFFFFF,3F1F0F0707
    030301,7F3F1F0F,FFFF7F7F3F3F3F3F
    ,FFFFF3C,F0F0F0E0E0C0C08,0F0F0F0
    F0F0F0F0F
280 DATA 0F0F0707030301 01,0101030307
    070F0F,0F0F0F0FFFFFFFFF,FFFFFFFF
    7F1F0701,FF3F0F03,FFFFFFFFFFFF0F0F
290 DATA F8FCFEFE7F3E,FFFFFFFFFFEFCF8
    F,F0F8F8FCFCFEFEFF,00808 0C0C0E0E
    0F,F0E0C08,FCFCF8F8F0F0F0F
300 DATA 8080C0C0E0E0F0F,0F1F3F7FFFF
    FFFFF,00000000030F3FFF,000000000
    0010307,E0E0E0F0F8FCFEFF,0000000
    00080C0E
310 DATA 00E0F0FEFFFFFFFF,0000000000
    E0F8FE,E0E0E1E3FFFFFEFC
320 L$="``````````````````"
330 RESTORE 370
340 FOR G=0 TO 10
350 READ S$(G),C$(G)
360 NEXT G
370 DATA TEXAS,AUSTIN,OKLAHOMA,OKLAH
    OMA CITY,ARKANSAS,LITTLE ROCK,LO
    UISIANA,BATON ROUGE,TENNESSEE,NA
    SHVILLE
380 DATA MISSISSIPPI,JACKSON,ALABAMA
    ,MONTGOMERY,FLORIDA,TALLAHASSEE,
    GEORGIA,ATLANTA
390 DATA SOUTH CAROLINA,COLUMBIA,NOR
    TH CAROLINA,RALEIGH
400 CALL CLEAR
410 PRINT "ONE OF THE UNITED STATES"
    ::"WILL BE OUTLINED.":::"TYPE TH
    E NAME OF THE STATE"
420 PRINT :"THEN PRESS <ENTER>.":::"
    IF THE STATE IS CORRECT,"
430 PRINT :"TYPE THE CAPITAL CITY"::
    "THEN PRESS <ENTER>."
440 PRINT :::"NAMES MUST BE SPELLED"
    ::"CORRECTLY TO BE ACCEPTED.":::
    TAB(15);"PRESS <ENTER>";
450 CALL KEY(0,K,S)
460 IF K<>13 THEN 450
470 CALL CLEAR
480 PRINT TAB(27);"ts":" i`````````
    ````yz{7 SPACES}u`e":" ";L$;"yx
    {3 SPACES}t`r":"h";L$;"`w vt``{"
490 PRINT "f";L$;"`` t``nq":"f";L$;"
    ``t```":"f";L$;"``````x":"f";L$;
    "``````e":"g";L$;"```````"
500 PRINT " c";L$;"````n":" g";L$;"`
    ``nq":"  j";L$;"``e":"
    {4 SPACES}kj``l``````````````":T
    AB(10);"a`````````ndj``p"
510 PRINT TAB(11);"bdc`ndddm
    {3 SPACES}co":TAB(13);"a`
    {8 SPACES}a`":TAB(14);"b";TAB(24
    );"b":::::
520 FOR C=0 TO 10
530 T=0
540 RANDOMIZE
550 R=INT(11*RND)
560 IF S$(R)="" THEN 550
570 ON R+1 GOTO 1500,1570,1630,1690,
    1730,1780,1840,1890,1930,1980,20
    20
580 CALL HCHAR(20,1,96,160)
590 READ N
600 FOR I=128 TO 127+N
610 READ G$
620 CALL CHAR(I,G$)
630 NEXT I
640 READ N
650 FOR I=1 TO N
660 READ X,Y,G
670 CALL HCHAR(X,Y,G)
680 NEXT I
690 FOR I=1 TO 7
```
```

```
700 CALL HCHAR(21,2+I,ASC(SEG$("STAT
    E ?",I,1)))
710 NEXT I
720 CALL HCHAR(21,11,96,15)
730 S1$=""
740 CALL SOUND(150,1397,2)
750 FOR L=1 TO 15
760 CALL KEY(0,K,S)
770 IF S<1 THEN 760
780 IF K=13 THEN 820
790 CALL HCHAR(21,10+L,K)
800 S1$=S1$&CHR$(K)
810 NEXT L
820 CALL SOUND(100,880,2)
830 IF S$(R)=S1$ THEN 950
840 CALL SOUND(100,330,2)
850 CALL SOUND(100,262,2)
860 T=T+1
870 IF T<2 THEN 720
880 CALL HCHAR(21,11,96,15)
890 FOR L=1 TO LEN(S$(R))
900 CALL HCHAR(21,10+L,ASC(SEG$(S$(R
    ),L,1)))
910 NEXT L
920 GOSUB 1380
930 C=C-1
940 GOTO 1250
950 GOSUB 1450
960 FOR I=1 TO 9
970 CALL HCHAR(23,2+I,ASC(SEG$("CAPI
    TAL ?",I,1)))
980 NEXT I
990 T=0
1000 CALL HCHAR(23,13,96,15)
1010 S1$=""
1020 CALL SOUND(150,1397,2)
1030 FOR L=1 TO 15
1040 CALL KEY(0,K,S)
1050 IF S<1 THEN 1040
1060 IF K=13 THEN 1100
1070 CALL HCHAR(23,12+L,K)
1080 S1$=S1$&CHR$(K)
1090 NEXT L
1100 CALL SOUND(100,880,2)
1110 IF C$(R)=S1$ THEN 1230
1120 CALL SOUND(100,330,2)
1130 CALL SOUND(100,262,2)
1140 T=T+1
1150 IF T<2 THEN 1000
1160 CALL HCHAR(23,12,96,15)
1170 FOR L=1 TO LEN(C$(R))
1180 CALL HCHAR(23,12+L,ASC(SEG$(C$(
     R),L,1)))
1190 NEXT L
1200 GOSUB 1380
1210 C=C-1
1220 GOTO 1250
1230 GOSUB 1450
1240 S$(R)=""
1250 READ N
1260 FOR I=1 TO N
1270 READ X,Y,G,J
1280 CALL HCHAR(X,Y,G,J)
1290 NEXT I
1300 NEXT C
1310 CALL HCHAR(21,1,96,96)
1320 PRINT "TRY AGAIN? (Y/N)";
1330 CALL KEY(0,K,S)
1340 IF K=89 THEN 330
1350 IF K<>78 THEN 1330
1360 CALL CLEAR
1370 STOP
1380 FOR I=1 TO 11
1390 CALL HCHAR(24,20+I,ASC(SEG$("PR
     ESS ENTER",I,1)))
1400 NEXT I
1410 CALL KEY(0,K,S)
1420 IF K<>13 THEN 1410
1430 CALL HCHAR(24,21,96,11)
1440 RETURN
1450 CALL SOUND(100,262,2)
1460 CALL SOUND(100,330,2)
1470 CALL SOUND(100,392,2)
1480 CALL SOUND(200,523,2)
1490 RETURN
1500 RESTORE 1510
1510 DATA 11,0000001F10F0C0C,000000F
     F,8080808.808080808080808,FF808
     0808080808,F808080808080808,080
     80601
1520 DATA 00000000C03807,00000000000
     00FF,00000000000000F00C,02020101
     01010101,12,14,12,128,14,13,129
1530 DATA 14,14,130,13,14,131,12,14,
     132,12,15,133,13,15,134,13,16,1
     35,13,17,136,13,18,137
1540 DATA 14,18,138,15,18,138,4,12,1
     4,96,2,13,14,96,5,14,12,96,7,15
     ,18,96,1
1550 DATA 5,5,96,2,3,6,96,1
1560 GOTO 580
1570 RESTORE 1580
1580 DATA 10,000000FF8080808,000000F
     F,000000FC04040404.040404040404
     0404,040404040404FC,00000000000
     00FF
1590 DATA 00000000C03807,08080601,F8
     0808080808080808,FF,12.11,14,128,
     12,14,137,11, 15,129,12,15,136
1600 DATA 13,15,135,11,16.129,13,16,
     134,11,17,129,13.17,133,11,18,1
     30,12,18,131.13,18,132,3
1610 DATA 11.14,96,5,12,14,96,5,13.1
     5,96,4
1620 GOTO 580
1630 RESTORE 1640
1640 DATA 9,000000000001F101,0000000
     00FF,0000000000F80404,08080F010
     1010102,040408081010101,2020E
1650 DATA 0000FF,1C0201,101010101010
     101,10,11,18,128,11,19,129,11,2
     0,130,12,20,131,13,20,132
1660 DATA 14,20,133,14,19,134,14,18,
     135,13,18,136,12,18,136,4,11,18
     ,96,3,12,18,96,3,13,18,96,3
1670 DATA 14,18,96,3
1680 GOTO 580
1690 RESTORE 1700
1700 DATA 5,0000FF808080808,0000F010
     10080808,08080403,000000E011080
     F0F,40404040808080808,5
1710 DATA 14,19,128,14,20,129,15,20,
     130,15,21,131,15,19,132,3,14,19
     ,96,2,15,19,96,2,15,21,110.1
1720 GOTO 580
1730 RESTORE 1740
1740 DATA 7,0000000F1010204.003FC,00
     FF,00FF0204040810E,010102FC,000
     000FF,408080FF,9,11,19,128
1750 DATA 11,20,129,11,21,130,11,22,
```

```
     130,11,23,131,12,22,132,12,21,1
     33,12,20,133,12,19,134
1760 DATA 2,11,19,96,5,12,19,96,4
1770 GOTO 580
1780 RESTORE 1790
1790 DATA 9,0000000101010204,000000F
     F,000000F01010101,1010101010101
     010,10101010FFFFFFFF
1800 DATA 0000F010111317 0F,20203F,08
     080808 10202,0808080810101 01,1
     0,12,20,128,12,21,129,12,22,130
1810 DATA 13,22,131,14,22,131,15,22,
     132,15,21,133,15,20,134,14,20,1
     35,13,20,136,6,12,20,96,3
1820 DATA 13,20,96,3,14,20,96,3,15,2
     0,96,1,15,21,110,1,15,22,100,1
1830 GOTO 580
1840 RESTORE 1850
1850 DATA 6,0000007F40404 04,000000F0
     10080804,0404040202020101,02020
     20101 0101FF,44444444FFFFFFFF
1860 DATA 4040404040404 04,7,12,22,12
     8,12,23,129,13,23,130,14,23,131
     ,15,22,132,14,22,133,13,22,133
1870 DATA 4,12,22,96,2,13,22,96,2,14
     ,22,96,2,15,22,100,1
1880 GOTO 580
1890 RESTORE 1900
1900 DATA 5,0F080808FFFFFFFF,FF00000
     0C0F0FCFF,00FF0000000000060E,00F9
     06,EFDFBF00BFDFEFFF,5,15,22,128
1910 DATA 15,23,129,15,24,130,15,25,
     131,16,27,132,4,15,22,100,1,15,
     23,106,1,15,24,96,2,16,27,32,1
1920 GOTO 580
1930 RESTORE 1940
1940 DATA 7,0000001F10080804,000000F
     808040203,8040202018040202,00F9
     06,80FF000000000060E,0202020101 0
     10101
1950 DATA 0404040202020101,7,12,23,1
     28,12,24,129,13,25,130,15,25,13
     1,15,24,132,14,23,133,13,23,134
1960 DATA 4,12,23,96,2,13,23,96,3,14
     ,23,96,1,15,24,96,2
1970 GOTO 580
1980 RESTORE 1990
1990 DATA 4,0000030C08040203,003CC3,
     10EC040201010307,8040202018040 2
     02,4,12,24,128,12,25,129,12,26,
     130
2000 DATA 13,25,131,3,12,24,96,2,12,
     26,110,1,13,25,96,1
2010 GOTO 580
2020 RESTORE 2030
2030 DATA 8,000102040408 10E,00FF,FF,
     0000000000000000FF,10EC010201010 3
     07,003CC3,000003FC,01010207,8
2040 DATA 11,24,128,11,25,129,11,26,
     130,10,27,131,12,26,132,12,25,1
     33,12,24,134,12,23,135,4
2050 DATA 11,24,96,3,10,27,96,1,12,2
     3,96,3,12,26,110,1
2060 GOTO 580
2070 END
```

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COMPUTE!
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VIC And 64 Escape Key

Thomas Henry

While programming, there are lots of ways to get trapped inside quotes and be unable to use the cursor controls. Until now, your only recourse was to hit RETURN and try the line again. With this handy utility, you can escape from "quote mode" traps by just hitting the pound sign key. The routine also serves as an example of machine language programming for those who are interested in trying their hand at it.

How many times has this happened to you? You're sitting at your VIC-20 or Commodore 64, entering or editing a program, and through a series of keystrokes that you probably don't even remember, get into the following trap. When you push a cursor movement key, instead of the cursor actually moving, you get a reverse field symbol on the screen. Frustrating, isn't it? As you have probably learned, about the only way to get free of the trap is to hit RETURN to get out of the line, and then start over.

Here's an easier way: a program that adds a valuable "escape" option to your computer. With this feature, the seldom used British pound symbol (£) becomes an escape key. When you are stuck in the "cursor trap" mentioned above, simply push the key; you will be released from what's called *the quote mode* and will be free to move the cursor as desired. Before looking at the program, let's examine the problem in greater detail.

Store Or Perform The Action

Some of the computer's keys are able to perform two distinct jobs, depending on whether the computer is in the immediate mode or program mode. These keys include LEFT, RIGHT, UP, DOWN, REV, OFF, CLEAR, HOME, INSERT, DELETE, and all of the color selection keys. In the immediate mode, you push one of these keys and the action is performed immediately. For example, depress the RIGHT key and the cursor moves one space to the right.

But one of the truly impressive features of all Commodore computers is their ability to store or save the action implied by the key. For example, here is a one-line program:

```
10 PRINT "{RIGHT} HELLO"
```

The string contains the word "HELLO" preceded by a cursor-right. When you type this line into the computer, the cursor-right movement is not performed; instead it is stored in the string. The cursor-right will be performed only when the program is run. We are storing a cursor movement to be executed later in the program mode. To indicate that a cursor-right movement is stored in the string, the computer will leave a reverse field brace symbol inside the quotes. In fact, every one of the keys mentioned above has a reverse field character which stands for it when it's inside quotes.

The trouble comes in when the computer thinks you're trying to store an action, but you want to perform it. There are a number of ways this can happen. One way is if you've typed in an odd number of quote marks while entering a line. Another way is pushing the insert key more times than you expected.

Escape By Machine Language

Having defined the problem, let's look at a program that will take care of it. Examine Program 1. This is the assembler listing of the VIC-20 "escape key" program. Since assemblers are now becoming quite common for the VIC and 64, enterprising users might wish to enter the source code in directly and assemble their own version. If you're an experimenter, you'll find that this is a great program to begin with. It's not too long, and yet not so short as to be a trivial exercise.


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Examine Program 1 now. The first part shows the "equates" for the program. These equates give names or labels to the various internal addresses that are used by the program. For example, NOKEYS stands for location $C6, and this location always contains the number of keystrokes stored in the keyboard buffer. IRQVEC stands for the IRQ vector stored in RAM (Random Access Memory). And so it goes for all of the labels. Each stands for a location, and usually the label suggests the meaning of the location in question.

The IRQ Routine

The escape key initialization occurs next. A new vector is stuffed into RAM, and this vector directs the computer to always jump to the start of the new IRQ routine. This routine occurs next in the listing. As this is the heart of the whole program, let's examine it in greater detail.

The first thing that happens here is that all of the registers are saved temporarily. Next, the last key depressed is examined. If it wasn't the British pound symbol (which is used for the escape key), then the registers are restored and the normal IRQ is finished. But if it is the desired key, then a zero is stored in three important locations. These are CMODE, REVERS, and NOINST. Stuffing a zero in CMODE turns off the quote mode, a zero in REVERS turns off the reverse screen mode, and a zero in NOINST nulls out the number of inserts pending. Turning off these three locations allows you to escape from all of the "offending" modes.

Blanking The Pound

Recall that a British pound symbol has been printed to the screen. A true escape key shouldn't print anything; it should simply "escape." So the next block of code deposits a blank on top of the British pound character and backs the cursor up one space. The net effect is that no residual character is printed. So a true escape key has been implemented.

Before going on to the rest of the normal IRQ routine (called IRQRTN in Program 1), the registers are restored. We have kept the new routine transparent to the normal VIC-20 operating system. For the Commodore 64, IRQRTN is $EA31 instead of $EABF.

Since there are now countless memory packages available for the VIC-20, some consideration must be given to finding a convenient location for the program. As mentioned, you might wish to assemble your own version. Most users, however, will want to use the BASIC loader in Program 2. This loader will put the program into the top of memory, wherever that might be. Thus, it works for all VIC-20's with any amount of extra memory (if any). For the Commodore 64, a minor change must be made to reflect the different value for IRQRTN, Line 230 should read:

```
230 DATA168,104,170,104,76,49,234
```

Make An Escape

To prepare a copy of this program for use, follow these steps:

1. Type in Program 2. If you have a Commo-

Program 1: Disassembly Of VIC Version

```
0000              NDKEYS = $C6          ;NUM8ER DF KEYS IN 8UFFER.
0000              REVERS = $C7          ;SCREEN REVERSE FLAG.
0000              ROW    = $D1          ;CURRENT CURSDR RDW.
0000              CDLUMN = $D3          ;CURRENT CURSDR CDLUMN.
0000              CMODE  = $D4          ;CURSDR MODE:0=DIRECT.
0000              INKEY  = $D7          ;LAST KEYSTRDKE IN.
0000              NDINST = $D8          ;NUM8ER OF INSERTS PENDING.
0000              KEY8RD = $0277        ;KEY8DARD 8UFFER.
0000              IRQVEC = $0314        ;IRQ VECTOR.
0000              IRQRTN = $EA8F        ;NDRMAL IRQ RDUTINE.
0000              ;
1000  78                 SEI
1001  A2 0D              LDX #<NEWIRQ ;SET UP NEW IRQ VECTDR.
1003  A0 10              LDY #>NEWIRQ
1005  8E 14 03           STX IRQVEC
1008  8C 15 03           STY IRQVEC+1
1008  58                 CLI
100C  60                 RTS          ;RETURN TO 8ASIC.
100D              ;
100D  48          NEWIRQ PHA          ;SAVE ALL REGISTERS.
100E  8A                 TXA
100F  48                 PHA
1010  98                 TYA
1011  48                 PHA
1012  A5 D7              LDA INKEY    ;GET LAST KEY PUSHED.
1014  C9 5C              CMP #$5C     ;IS IT 8RITISH PDUND SIGN?
1016  D0 17              8NE MDVEDN   ;8RANCH IF NDT.
1018  A2 00              LDX #$00     ;YES.
101A  86 D4              STX CMODE    ;TURN QUDTE MODE OFF.
101C  86 C7              STX REVERS   ;TURN REVERSE MDDE DFF.
101E  86 D8              STX NDINST   ;TURN INSERT MDDE OFF.
1020  E8                 INX          ;TELL THE K8D 8UFFER THAT
1021  86 C6              STX NDKEYS   ;IT CDNTAINS DNE KEYSTROKE.
1023  A4 D3              LDY COLUMN
1025  88                 DEY          ;MOVE CURSOR BACK DNE SPACE.
1026  A9 20              LDA #$20     ;THEN DEPDSIT A 8LANK.
1028  91 D1              STA (RDW),Y
102A  A9 9D              LDA #$9D     ;FINALLY, PUT A CURSOR LEFT
102C  8D 77 02           STA KEY8RD   ;IN THE KEYBOARD 8UFFER.
102F  68          MDVEON PLA          ;RESTDRE ALL REGISTERS.
1030  A8                 TAY
1031  68                 PLA
1032  AA                 TAX
1033  68                 PLA
1034  4C 8F EA           JMP IRQRTN   ;FINISH NORMAL INTERRUPT.
```

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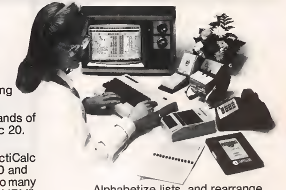

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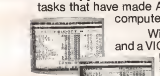

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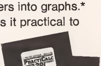

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dore 64, be sure to make the change to line 230 mentioned above.

2. Check for errors.

3. Save the program first.

4. Now try it out. Type RUN and hit RETURN.

5. Almost instantly, the program will relocate to the top of memory and perform a self-initialization. You may leave the program in place for the duration of a programming session; it will not interfere with normal BASIC operation.

Typing NEW will not affect the escape key program, but if you hit the RUN-STOP/RESTORE key combination, the program will be disabled. You can re-enable it quite easily by typing:

SYS 256*PEEK(56) + PEEK(55)

Since cassette operations affect the IRQ loop, you may wish to disable the escape option with a RUN-STOP/RESTORE before doing any loading or saving and re-enable it afterwards with the SYS 256*PEEK(56) + PEEK(55).

If you have the program in place, try it out. For example, type a quote mark. Now hit the RIGHT key a number of times. Do you see the reverse field brace? Now hit the British pound key. Then hit the RIGHT key once more. Notice that this time you actually move to the right. Think of the most outlandish combination of keystrokes that you can, then try the escape.

Program 2: BASIC Loader

```
100 T=256*PEEK(56)+PEEK(55)-55:GOSUB160
110 POKE56,HI%:POKE55,LO
120 FORA=TTOT+54:READD:POKEA,D:NEXT
130 X=T:T=T+13:GOSUB160:POKEX+2,LO:POKEX
    +4,HI%
140 SYS(X)
150 NEW
160 HI%=T/256:LO=T-HI%*256:RETURN
170 DATA120,162,13,160,16,142,20,3
180 DATA140,21,3,88,96,72,138,72
190 DATA152,72,165,215,201,92,208,23
200 DATA162,0,134,212,134,199,134,216
210 DATA232,134,198,164,211,136,169,32
220 DATA145,209,169,157,141,119,2,104
230 DATA168,104,170,104,76,191,234
```

©

Musical Atari Keyboard

Paul N. Havey

This program makes your Atari into a musical instrument. The sound of bells, piano, organ, etc. – it's all in your computer's keyboard.

"Music Keyboard 3" makes the Atari typewriter keyboard a music keyboard.

You can play the keyboard much like playing an organ. Strike a key, the note plays; release the key, the note stops. You can also change the decay of a note to sound like a piano, organ, or bells, and you can change registers to bass or treble with the SHIFT key.

Features

1. Variable decay of a note
2. Preset attack and release
3. Five octave range (C1 to C6)
4. Two-tier keyboard
5. Keyboard display on the screen
6. Monotonic (one note at a time)
7. Fast action

When you run this program, a picture of the Atari keyboard appears on the screen. The keys that are outlined only are not usable as notes. The white and black keys represent the same keys on a keyboard instrument.

Here's how to use the program:

- Starting-up
  1. Insert the Atari BASIC cartridge.
  2. Load or type into RAM memory Music Keyboard.
  3. Type RUN, then press RETURN.
  4. When the prompt "INPUT DECAY (0-1)" appears in the lower left section of the screen, type in a decimal number between zero and one (example: 0.89) and then press the RETURN key.
  5. When the word "PLAY" appears, begin playing.
- Changing the decay of a note after starting up:
  1. Press the space bar.
  2. Press the BREAK key.
  3. Type GOTO 1000, then press the RETURN key.
  4. When "INPUT DECAY (0-1)" appears, type in the decay value, then press RETURN.
  5. When the word "PLAY" appears, begin playing.
- Changing registers
  1. Press the SHIFT key.

Fast Keyboard Action

The Serial Port Control register, SKCTL, changes whenever a key is pressed or released. By reading SKCTL and using the value it contains as an expression in a GOTO statement, the program can decide what to do. SKCTL detects one of four possible keyboard conditions: the SHIFT and one of the character keys pressed together; the SHIFT key pressed by itself; a character key pressed by itself; or no key pressed at all.

Here are a few tricks used to get fast keyboard action. First, the value in SKCTL is used in the GOTO statements to direct the flow of control. Second, placing the logic for note playing at the beginning of the program increases speed since a GOTO target is found by searching a program from beginning to end. Third, removing the REM statements at the beginning leaves fewer statements to search to find the referenced line number. Fourth, using GRAPHICS 2 increases speed over GRAPHICS 0 by 20 percent. The display exists for reasons other than just showing the keyboard. Fifth, converting audio frequency codes to notes on the keyboard by table look-up avoids time-consuming computation. The keyboard code is used as an index to an array containing the frequency for that note. Sixth, POKEs are used instead of the SOUND statement.

Program Description

This program has three major sections. Lines 243-256 will cause a note to play when you press a key. Table 3 lists the SKCTL keyboard condition codes. Lines 400-1530 set up the display, the re-

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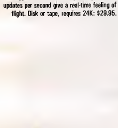

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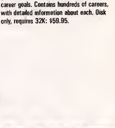

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defined characters, and the variables for the play section. Lines 1560-4000 contain data for the note and character tables.

Line 240 directs the program to the setup section. After setup is complete, control goes to the play section.

Lines 243-244 contain the action the program takes with both the SHIFT and a character key pressed. A note decays while the register changes. The register cannot change again until the SHIFT key is released. Lines 247-248 are accessed only if the SHIFT key alone is pressed. A register change – from bass to treble or from treble to bass – occurs, but no decay or release action is necessary.

Lines 251-253 direct the program to play a note if a character key only is pressed. The note does not change unless it is different from the last note played. The register changes from bass to treble or vice versa when a key on the keyboard is first pressed. The note decays as long as the same key is held down. Lines 255-256 take effect if no key is pressed. The sound stops and remains that way until another key is pressed.

The setup logic begins on line 520. Program variables are initialized on lines 520-530. Lines 540-570 select the screen mode and colors and print the title to the screen. Lines 600-630 transfer the treble and bass register notes into an array.

The table on page 58 of the *Atari BASIC Reference Manual* gives the hardware frequency codes with musical note values for the treble register. The bass register table, not found in any Atari manual, is in Table 4 of this article.

Lines 710-750 read the redefined character set data and place the entire character set in a new location. Lines 760-820 display the redefined characters as a picture of the keyboard. Table 5 gives the color factor to add to the character code. Lines 1000-1020 prompt the user to input the decay value and play. Lines 1520-1530 wait until no key is pressed to start the play logic.

Musical Atari Keyboard

```
240 GOTO 500
243 POKE 53761,T+L:L=L*DECAY*(L>0.5)
    :IF S<3 THEN R=R=0
244 S=4:GOTO PEEK(53775)
247 POKE 53761,T+L:L=L*0.5*(L>0.5):I
    F S<3 THEN R=R=0
248 S=3:GOTO PEEK(53775)
251 NP=PEEK(53769):IF NP-P OR S-2 TH
    EN P=NP:POKE 53768,R:REG=64*R:L=
    LOUD:POKE 53760,P(REG+P)
252 POKE 53761,T+L:L=L*DECAY*(L>0.5)
253 S=2:GOTO PEEK(53775)
255 POKE 53761,T+L:L=L*0.5*(L>0.5)
256 S=1:GOTO PEEK(53775)
400 REM *** SET-UP SECTION ***
```

Table 1: Program Variables*

Name	Description
A	temporary data
CHR	character number plus color code
DECAY	user option value
I	temporary index
L	current loudness
LOUD	maximum loudness
NP	new pitch table index
P	current pitch table index
R	Audio Control value (AUDCTL)
REG	pitch table register index
REP	number of character repeats
S	prior key pressed code
T	Audio Tone value
X	current character position – horizontal
XREF	left-most keyboard position
Y	current character position – vertical
YREF	upper-most keyboard position

**Also see Table 2*

Table 2: Hardware And O/S (PEEK & POKE) Descriptions

Name*	Address	Description
AUDF1	53760	Audio Channel 1 Freq.
AUDC1	53761	Audio Channel 1 Control
AUDCTL	53768	Audio Control
KBCODE	53769	Keyboard Code
SKCTL	53775	Serial Port Control
RAMTOP	106	Size defined by power ON
CRSINH	752	Cursor Inhibit (0 = Cursor On)
CHBAS	756	Character Base Register
CHRORG	57344	Character Set

**Also see the* Atari Operating System User's Manual

Table 3: Serial Port Control Keyboard Codes

Keys Pressed	Code
Character*	251
Shift	247
Shift/Character	243
No Key	255

**Excludes the BREAK, SHIFT, and CTRL keys.*

```
500 REM REDEF. CHARS. - DISPLAY
520 LOUD=15:T=160:SOUND 0,0,0,0
530 REG=0:R=0
540 GRAPHICS 2:SETCOLOR 1,0,12
550 SETCOLOR 2,15,6:SETCOLOR 3,0,4
560 SETCOLOR 4,15,6:SETCOLOR 0,0,0
570 ? #6;" MUSIC KEYBOARD  2.0":POKE
     752,1:? " PLEASE WAIT"
600 DIM P(255)
610 FOR I=0 TO 127
620 READ P:P(I)=P:P(I+128)=P
630 NEXT I
710 CHSET=(PEEK(106)-8)*256
720 CHORG=57344
730 FOR I=0 TO 511:POKE CHSET+I,PEEK
    (CHORG+I):NEXT I
740 FOR I=8 TO 11*8+7:READ A:POKE CH
    SET+I,A:NEXT I
750 POKE 756,CHSET/256:XREF=1:YREF=2
```

Table 4:
Bass Register Pitch Codes
(TONE = 10   AUDCTL = 1)

Pitch	AUDFX	Pitch	AUDFX
C4	29	F2	89
B3	31	E2	94
(Bb3 or A#3)	33	(Eb2 or D#2)	100
A3	35	D2	106
(Ab3 or G#3)	37	(Db2 or C#2)	112
G3	39	C2	119
(Gb3 or F#3)	41	B1	126
F3	44	(Bb1 or A#1)	134
E3	47	A1	142
(Eb3 or D#3)	49	(Ab1 or G#1)	150
D3	52	G1	159
(Db3 or C#3)	56	(Gb1 or F#1)	169
C3	59	F1	179
B2	63	E1	190
(Bb2 or A#2)	66	(Eb1 or D#1)	201
A2	70	D1	213
(Ab2 or G#2)	75	(Db1 or C#1)	226
G2	79	C1	239
(Gb2 or F#2)	84	B0	253

Table 5: Character Color Codes

Color	Code
Black	32
White	0
Gray	128
Orange*	160

**Background*

Notes:

1. Redefined characters have Atari internal code numbers one to eleven inclusive.

2. Adding color code above to internal code displays characters in that color.

3. For more information, see the *Atari BASIC Reference Manual*, chapter nine.

```
760 FOR Y=1 TO 5:X=1
770 READ CHR,REP:IF CHR+REP=0 THEN 8
    20
780 COLOR CHR
790 PLOT XREF+X,YREF+Y:X=X+1
800 REP=REP-1:IF REP THEN 790
810 GOTO 770
820 ? #6:NEXT Y
1000 POSITION 13,9:? #6;"{4 SPACES}"
1010 POKE 752,0:? "{CLEAR}INPUT DECA
     Y [0-1]":INPUT DECAY:POKE 752,1
     :?
1020 POSITION 13,9:? #6;"PLAY"
1520 IF PEEK(53775)-255 THEN 1520
1530 GOTO 255
1560 REM TREBLE REGISTER DATA
1600 DATA 114,136,102,0,0,0,0,85
1610 DATA 35,0,31,45,0,40,30,0
1620 DATA 182,0,193,0,0,162,217,243
1630 DATA 0,0,68,50,0,57,76,85
1640 DATA 121,0,108,144,0,128,96,91
1650 DATA 60,0,64,47,91,53,72,81
1660 DATA 37,0,33,0,0,42,0,0
1670 DATA 0,153,204,0,0,172,230,0
1674 REM BASS REGISTER DATA
1680 DATA 112,134,100,0,0,0,0,84
1690 DATA 35,0,31,44,0,39,29,0
1700 DATA 179,0,190,0,0,159,213,239
1710 DATA 0,0,66,49,0,56,75,84
1720 DATA 119,0,106,142,0,126,94,89
1730 DATA 59,0,63,47,89,52,70,79
1740 DATA 37,0,33,0,0,41,0,0
1750 DATA 0,150,201,0,0,169,226,0
1790 REM NEW CHARACTERS
1800 DATA 0,60,66,66,66,66,60,0
1810 DATA 0,3,4,4,4,4,3,0
1820 DATA 0,195,36,36,36,36,195,0
1830 DATA 0,60,126,126,126,126,60,0
1840 DATA 0,3,7,7,7,7,3,0
1850 DATA 0,195,231,231,231,231,195,
     0
1860 DATA 0,255,255,255,255,255,255,
     0
1870 DATA 0,252,2,2,2,2,252,0
1880 DATA 0,252,254,254,254,254,252,
     0
1890 DATA 0,63,127,127,127,127,63,0
1900 DATA 0,195,228,228,228,228,195,
     0
2000 REM CHARACTER DISPLAY DATA
2020 DATA 129,1,36,3,129,1,36,2
2030 DATA 129,1,36,3,129,4,0,0
2040 DATA 10,1,6,11,11,1,3,1
2050 DATA 8,1,0,0
2060 DATA 37,1,41,1,129,1,36,2
2070 DATA 129,1,36,3,129,1,36,2
2080 DATA 129,1,36,1,129,1,0,0
2090 DATA 5,1,7,1,6,12,9,1,0,0
3000 DATA 160,3,138,1,135,7,137,1
3010 DATA 160,3,0,0
4000 END
```

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3-D Color Computer Patterns

George Trepal

Watching your computer trace harmonic visual figures and then rotating the completed patterns can be a most pleasant experience. Use these two programs to plot points, at different speeds, for your patterns.

The computer is capable of turning out interesting and complex Lissajous patterns. Imagine the patterns as being shadows cast by a three-dimensional wire frame on a turntable which can be rotated full circle, 360 degrees. The computer can do this rotation.

Note that the illustrations use small numbers to produce the patterns. Big numbers are much more interesting. One of my favorites is the combination 22 and 21. Numbers higher than 30 exceed the screen resolution and a blob results.

Both programs here use POKE 65495,0. In most Color Computers this POKE speeds up the machine so that it draws faster. Unfortunately, it throws off several important functions such as the ability to make sounds, load or save tapes, or use a printer. To get rid of the speed POKE, you can either press the reset button or POKE 65494,0.

Program 1 lets you rotate the pattern and is rather slow. Program 2 is much faster, but it doesn't allow the pattern to be rotated. Program 2 looks up in a table the place to draw the next line to; this is much faster than calculating each new position, as Program 1 does.

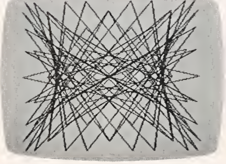
Program Calculations

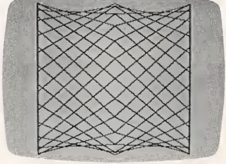
Here's a technical description of Program 1. You can skip the math and just enjoy the art, unless you're curious.

Lissajous patterns are formed by a sine wave of frequency X modulating a sine wave of frequency Y. The result has to be plotted on circular coordinates. Rotation of a pattern is done by altering the phase of one wave in relation to the other.

Lines 20 through 90 give the speed POKE, clear variables, and take in parameters.

Lines 100 to 150 are constants used in the calculations. The reason for letting variables represent the constants is speed. The computer has to change a number into its floating point representation before it can work with it. The process is highly complex and takes time. Since BASIC is interpreted rather than compiled, every time the





program sees a number it has to change it over. Variables are stored in floating point form, however, and simply have to be looked up in memory. This is much faster.

The delay loop in line 160 can be left out without hurting the program. Some people who have played with the program have been startled by the sudden switch from text to graphic screen and have managed to hit interesting things on the keyboard. The delay gives fingers a fraction of a second to move to a less dangerous position.

Lines 170 to 220 are just setting up parameters. The program will calculate a point and draw a line to it and then repeat the process. Lines 210 and 220 calculate an arbitrary line length. The idea is to achieve a compromise between a slowly drawn, beautiful pattern and a quickly drawn, jagged pattern.

Lines 230 and 240 produce the sine calculations. The multiplier expands the pattern to fill the screen. The number added to the end shifts the pattern so that the center of the pattern is also the center of the screen.

Lines 250 and 260 help to make things look a little better. Leave them out of the program to see why. Line 280 checks to see if you've pressed the space bar and want a new pattern.

Program 1: Plotting Points Calculated

```
20 POKE65495,0{3 SPACES}'THIS POKE D
   OUBLES THE SPEED OF MOST COLOR CO
   MPUTERS
30 CLS:PRINT:PRINT
40 PRINT"  PRESS THE SPACE BAR TO ST
   ART{4 SPACES}OVER AGAIN."
50 PRINT
60 C = 0:Z = 0:B = 0
70 PRINT " HORIZONTAL AXIS";:INPUT H
80 PRINT " VERTICAL AXIS";: INPUT V
90 PRINT"VIEWING ANGLE 0 TO 360";:IN
   PUT P
100 RA=57.2957
110 NT=90
120 NF=95
130 OT=120
140 TS=127
150 E=8
160 FOR I = 1 TO 90: NEXT I
170 P=P/RA
180 PMODE 4,1:PCLS:SCREEN 1,1
190 IF V>=H THEN M = V
200 IF H>V THEN M = H
210 Z = Z + H*(E/M)
220 B = B + V*(E/M)
230 Y=INT((SIN(Z/RA + P)*OT)+TS)
240 A=INT((SIN(B/RA)*NT)+NF)
250 C = C + 1
260 IF C =<4 THEN GOTO 300
270 LINE -(Y,A), PSET
280 IF INKEY$= " " THEN GOTO 320
290 GOTO 210
300 LINE -(Y,A), PRESET
310 GOTO 210
320 CLS
330 GOTO 30
```

Program 2: Plotting Points Read From Table

```
20 CLS:PRINT
30 POKE 65495,Ø{3 SPACES}'THIS POKE
   DOUBLES THE SPEED OF MOST COLOR C
   OMPUTERS
5Ø PRINT "  NOTE: AFTER YOU ARE THRO
   UGH{5 SPACES}USING THIS PROGRAM P
   USH THE{5 SPACES}RESET BUTTON ON
   THE BACK OF{5 SPACES}THE COMPUTER
   .  YOU WON'T BE{5 SPACES}ABLE TO
   CLOAD UNLESS YOU DO{5 SPACES}THIS
   ."
6Ø PRINT
7Ø PRINT "  TO USE THIS PROGRAM PRES
   S{7 SPACES}ANY KEY AFTER YOU HEAR
    THE{6 SPACES}THE BEEP."
8Ø DATA 128,13Ø,132,135,137,139,141,
   143,146,148,15Ø,152,154,157,159,1
   61,163,165,167,169,171,174,176,17
   8,18Ø,182,184,186,188,19Ø,192,193
   ,195,197,199,2Ø1,2Ø3,2Ø4,2Ø6,2Ø8,
   21Ø,211,213,215,216,218,219,221
9Ø DATA 222,224,225,227,228,229,231,
   232,233,235,236,237,238,239,24Ø,2
   41,242,243,244,245,246,247,247,24
   8,249,249,25Ø,251,251,252,252,253
   ,253,253,254,254,254,255,255,255,
   255,255,255,255,255,255,255,255
1ØØ DATA 254,254,254,253,253,253,252
    ,252,251,251,25Ø,249,249,248,247
    ,247,246,245,244,243,242,241,24Ø
    ,239,238,237,236,234,233,232,231
    ,229,228,227,225,224,222,221,219
    ,218,216,215,213,211,21Ø,2Ø8,2Ø6
    ,2Ø4
11Ø DATA 2Ø3,2Ø1,199,197,195,193,191
    ,19Ø,188,186,184,182,18Ø,178,176
    ,173,171,169,167,165,163,161,159
    ,157,154,152,15Ø,148,146,143,141
    ,139,137,135,132,13Ø,128,126,124
    ,121,119,117,115,112,11Ø,1Ø8,1Ø6
    ,1Ø4
12Ø DATA 1Ø2,99,97,95,93,91,89,87,85
    ,82,8Ø,78,76,74,72,7Ø,68,66,64,6
    3,61,59,57,55,53,52,5Ø,48,46,45,
    43,41,4Ø,38,37,35,34,32,31,29,28
    ,27,25,24,23,21,2Ø,19,18,17,16,1
    5,14,13,12,11,1Ø,9,9,8,7,7,6,5,5
    ,4,4,3,3,3,2,2
13Ø DATA 2,1,1,1,1,1,1,1,1,1,1,1,2,2
    ,2,3,3,3,4,4,5,5,6,7,7,8,9,9,1Ø,
    11,12,13,14,15,16,17,18,19,2Ø,22
    ,23,24,25,27,28,29,31,32,34,35,3
    7,38.4Ø,41,43,45,46,48,5Ø,52,53,
    55,57,59,61,63,65,66,68,7Ø,72,74
14Ø DATA 76,78,8Ø,83,85,87,89,91,93,
    95,97,1ØØ,1Ø2,1Ø4,1Ø6,1Ø8,11Ø,11
    3,115,117,119,121,124,126,128
15Ø DIM X(36Ø)
16Ø FOR J=Ø TO 36Ø
17Ø READ X
18Ø X(J)=X
19Ø NEXT J
2ØØ DATA 96,98,99,1Ø1,1Ø3,1Ø4,1Ø6,1Ø
    8,1Ø9,111,112,114,116,117,119,12
    1,122,124,125,127,128,13Ø,132,13
    3,135,136,138,139,141,142,144,14
    5,146,148,149,15Ø,152,153,154,15
    6,157,158,16Ø,161,162,163,164.16
    5,167,168,169,17Ø,171,172,173.17
    4
```

```
210 DATA 175,176,177,177,178,179,180
    ,181,181,182,183,183,184,185,185
    ,186,186,187,187,188,188,189,189
    ,189,190,190,190,190,190,191,191
    ,191,191,191,191,191,191,191,191
    ,191,190,190,190,190,190,189,189
    ,189,188,188,187,187,186,186,185
    ,185
220 DATA 184,183,183,182,181,181,180
    ,179,178,177,177,176,175,174,173
    ,172,171,170,169,168,167,165,164
    ,163,162,161,160,158,157,156,154
    ,153,152,150,149,148,146,145,143
    ,142,141,139,138,136,135,133,132
    ,130,128,127,125,124,122,121,119
    ,117
230 DATA 116,114,112,111,109,108,106
    ,104,103,101,99,98,96,94,93,91,8
    9,88,86,84,83,81,79,78,76,75,73,
    71,70,68,67.65,63,62,60,59,57,56
    ,54,53,51,50,48,47,46,44,43,41,4
    0,39,37,36,35,34,32,31,30,29,28,
    26,25,24,23,22,21,20,19,18,17,16
    ,15,15,14,13,12,11,11
240 DATA 10,9,9,8,7,7,6,6,5,5,4,4,3,
    3,3,2,2,2,2,2,1,1,1,1,1,1,1,1,1,
    1,1,2,2,2,2,2,3,3,3,4,4,5,5,6,6,
    7,7,8,9,9,10,11,11,12,13,14,15,1
    5,16,17,18,19,20,21,22,23,24,25,
    27,28,29,30,31,32,34,35,36,38,39
    ,40,42,43,44,46,47,49,50,51,53,5
    4,56
250 DATA 57,59,60,62,64,65,67,68,70,
    71,73,75,76,78,80,81,83,84,86,88
    ,89,91,93,94,96
260 DIM Y(360)
270 FOR J=0 TO 360
280 READ Y
290 Y(J)=Y
300 NEXT J
310 POKE 65494,0:SOUND 100,2:POKE 65
    495,0
320 IF INKEY$<>"" THEN GOTO 330 ELSE
     GOTO 320
330 CLS
340 PRINT:PRINT" PRESS THE SPACE BAR
     TO STOP AN  OLD PATTERN AND STA
    RT A NEW{5 SPACES}ONE.":PRINT:PR
    INT
350 PRINT @ 160,"  ENTER A NUMBER FO
    R THE HORI-{4 SPACES}ZONTAL AXIS
    "
360 INPUT "  ";X
370 IF X<0 THEN PRINT @ 224,"
    {18 SPACES}":GOTO 350
380 PRINT @ 256:PRINT "  ENTER A NUM
    BER FOR THE VER-{5 SPACES}TICAL
    AXIS"
390 INPUT "  ";Y
400 IF Y<0 THEN PRINT @ 352,"
    {13 SPACES}":GOTO 380
410 XP=0:YP=0
420 LINE (128,96)-(128+XP,96+YP),PRE
    SET
430 PMODE 4,1:PCLS(5):SCREEN 1,1
440 XP=XP+X
450 YP=YP+Y+PH
460 IF XP>360 THEN XP=XP-360
470 IF YP>360 THEN YP=YP-360
480 LINE -(X(XP),Y(YP)),PRESET
490 IF INKEY$=" " THEN GOTO 330
500 GOTO 440
```

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VIC-20/64 Translations: Reading The Keyboard

Nathan Okun

When I bought my Commodore 64 computer, I recognized that there was very little software written expressly for my machine. But, because of its similarity to the VIC-20, I thought it would be possible to modify most – if not all – VIC programs with minimal effort to run on my computer, too.

A considerable number of locations used by the machines for internal workings are identical in both VIC and 64 memory maps, especially the first several hundred locations up through 831. The cassette buffers are given to location 1019, but some of the 64 sprites use memory from 832 to 1022, so this area is not directly compatible in most cases.

Also, even though the addresses are different, a number of locations seem to be used for the same purpose (excluding the screen and sound processing logic, of course). I recognized that the *contents* of many of these locations would be different, especially those holding addresses of memory limits and the like, but I expected that all of the differences would be straightforward, easily understood changes.

While a great many changes are straightforward, I quickly found a few locations that were not working in the same manner in both machines. Since it will be some time before I walk through enough VIC programs to hit all of the differences that exist, I decided to acquaint some 64 owners immediately with some of the pitfalls I discovered in my VIC to 64 translations. At least this will make you more cautious and keep you from wondering if your machines are broken when you get some weird results.

Hidden Keyboard Differences

In *COMPUTE!'s First Book Of VIC*, the article "Extended Input Devices: Paddles And The Keyboard," by Mike Bassman and Salomon Lederman, explains how the paddle works and how the VIC-20 handles its keyboard input logic, using the "polled" keyboard concept. This was one of my first translation attempts, since it seemed so easy to translate to the 64. After all, the keyboards of both machines are identical, right?

Wrong!

After a little work, I altered the VIC programs 2 and 3 in the article to programs 1 and 2 here. The differences are minor – I used a comma instead of a semicolon in the key code PRINT statement, for example. The hardest part was handling location 808 to turn off the RUN/STOP key's BASIC program BREAK effect. In the VIC, the normal value of this location is 112, but in the 64 it has a normal value of 237.

Changing this location to other values caused some problems until I found that setting it to zero seemed to work. I have no idea if this affects some other portion of the operating system, so the use of zero may not be universally correct.

Once it was written, I fully expected the keyboard matrix table of my 64 to be identical to that of the VIC. When I ran the program, however, I got considerably different results. I double-checked my program several times and could not find any mistakes, so I decided to compile my own 64 keyboard matrix table and see how things differed. Table 1 is the result. Note that the entire table is a transposition (axes swapped) of the VIC matrix with a couple of rows and columns rearranged. Apparently, the 64 designers wanted the RUN/STOP key to be in the upper left corner (127,127), so they made extensive changes for this and perhaps other reasons.

Once I realized that the polling values were different, I rewrote a VIC program which PEEKed into memory to read the character codes where they are stored. The program reads the character codes in location 197 as set by the BASIC program after BASIC has done its own polling of the keyboard. This location has the same meaning in the 64 as it has in the VIC.

At line 5 I added a POKE 808,0 to disable the STOP key's BREAK effect and thus allow me to find out its character code. As with the VIC, the SHIFT keys, the CTRL key, the COMMODORE key, and the RESTORE key have no effect on the value in location 197 – which is 64 when no

key is being pressed. My version of the PEEK program has the values running continuously up the TV screen in four columns, just like the version of the polling program that I used.

64's Hierarchy Of Keys

As suspected, the character codes were scrambled when compared to the VIC codes – in only a couple of cases were they the same. Table 2 shows the Commodore 64 character codes for each key. There is also a definite hierarchy in the keys so that if two or more are held down simultaneously, one of them always takes precedence unless an even higher-precedence key is added to the group. The character code number seems to be the order of precedence, with the higher number overriding any lower character number if both are pressed – RUN/STOP has the highest precedence in Table 2 and overrides any other key or keys.

If RUN/STOP is held down after another key has already been pressed and held, it won't cause a BREAK in those cases where the row select code in Table 1 is the same for the two keys when location 808 is returned to the normal 237 value. Apparently, the RUN/STOP key has been "fail-safed" to keep it from BREAKing a program unless the RUN/STOP key, and only the RUN/STOP key, is hit.

The above examples should make it very obvious that there are a number of subtle, but still critical, differences between the Commodore 64 and the VIC-20. Who would have imagined that they would change the keyboard logic when both machines use identical keyboards? Caution is definitely in order.

I now know of the following categories of VIC-20/Commodore 64 differences:

1. Screen and sound chip locations and related logic.

2. Sprite data storage and logic (VIC-20 has no sprites).

3. RAM areas (location, not contents – Commodore 64 is much larger here).

4. ROM operating system logic areas (VIC-20 has a larger operating system).

5. Contents of lower memory BASIC/operating system working areas (limit-of-memory registers and so forth in locations 0-831), though *most* will be straightforward changes from the VIC-20 contents (perhaps there are more differences such as the one in location 808).

6. LOAD/SAVE procedures (VIC-20 is considerably less complex, but this is one of the things that requires its extensive operating system memory area).

7. Keyboard polling values (Table 1) and character codes (Table 2).

8. Extra built-in joystick port and extra TV RF output in addition to the NTSC color monitor

How To Read Table 1:
The key code value is set into location 56321 when the indicated key is hit *and* that key's row has been previously selected by POKEing row select code into location 56320; otherwise, the value of 255 will be in location 56321. The indicated value will remain set as long as the key remains depressed. (Commodore 64 keyboard hardware does the setting automatically.) If more than one key *in a row* is hit simultaneously, the key codes are ORed together.

Table 1: Commodore 64 Keyboard Matrix Table

Key Code (for PEEK) Returned From Location 56321 ($DC01)
(Contents of Location 56321 = 255 Otherwise)

Legal Keyboard Row Select Code Values (Must Be POKEd Into Location 56320 ($DC00))

	127	191	223	239	247	251	253	2S4
127	RUN STOP	Q	COMMO-DORE	SPACE	2	CTRL	←	1
191	/	↑	=	RIGHT SHIFT	HOME	;	*	£
223	,	@	:	.	-	L	P	+
239	N	O	K	M	0	J	I	9
247	V	U	H	B	8	G	Y	7
251	X	T	F	C	6	D	R	5
253	LEFT SHIFT	E	S	Z	4	A	W	3
2S4	↑CURSOR↓	f5	f3	f1	f7	←CURSOR→	RETURN	DEL

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output port (lots of tricks probably possible with these!)

Other hidden differences are probably waiting for the unwitting Commodore 64 owner to stumble over when he wants to use a VIC program. I hope that anyone who does find some will write in to tell the rest of us.

Table 2:

Character Codes Returned From Location 197 For Each Key Entry (Commodore 64)

KEY	CHAR CD	KEY	CHAR CD	KEY	CHAR CD	KEY	CHAR CD
←	57	Q	62	STOP	63	Z	12
1	56	W	9	A	10	X	23
2	59	E	14	S	13	C	20
3	8	R	17	D	18	V	31
4	11	T	22	F	21	B	28
5	16	Y	25	G	26	N	39
6	19	U	30	H	29	M	36
7	24	I	33	J	34	,	47
8	27	O	38	K	37	.	44
9	32	P	41	L	42	/	55
0	35	@	46	:	45	CRSR DN	7
+	40	*	49	;	50	CRSR RT	2
-	43	↑	54	=	53	SPACE	60
£	48	f1	4	RETURN	1		
HOME	51	f3	5				
DEL	0	f5	6				
		f7	3				

NO KEY = SHIFT KEY (either) = CTRL KEY = COMMODORE KEY = RESTORE KEY = 64 as CHAR CODE

Program 1:

Machine Language Program To Capture Key Code Before Changed By BASIC. (Incorporated as a BASIC loader in Program 2.)

Note: Change 127 ($7F) to any of the other legal row select values, depending on the key used. See Table 1. The routine is needed because the BASIC interpreter is continually changing the row select value to 127 to check for a STOP input from the keyboard at the end of every command, so we must grab the key code for our key by setting the desired row select and saving our key code for that row before the end of any BASIC instruction. It is used in Program 2, and it can be used in any program you create to check for keyboard inputs.

(Hex)			Assembly		Comments
A9	7F		LDA	#$7F	;Row select code = 127 (example)
8D	00	DC	STA	$DC00	;Set row select code (56320)
AD	01	DC	LDA	$DC01	;Get key code from 56321
8D	FF	9F	STA	$9FFF	;Save key code at 40959
60			RTS		;Return

Note: Higher values of the CHAR CODE override lower values if two or more keys are pressed simultaneously. If any key in the 127 *row* of Table 1 is held down prior to pressing the RUN/STOP key, location 197 will change to 63 but a BREAK will not occur.

Program 2:

Disable RUN/STOP Key And PRINT Key Code Of Pressed Key(s)

Note: You will probably want to delete REM statements when you key this in. Also, putting 0 in location 808 works, but this is an important location and a value of 0 might not be correct for every program

```
5 POKE 8Ø8,Ø:REM NORMAL VALUE=237. DISAB
   LES RUN/STOP WHEN = Ø.
8 REM LINE 1Ø CUTS OUT 21 BASIC RAM LOCA
   TIONS
1Ø POKE 51,235:POKE 52,159:POKE 55,235:PO
   KE 56,159
2Ø FOR K=Ø TO 11:READ X:POKE 4Ø94Ø+K,X:NE
   XT:REM LOAD MACHINE LANGUAGE
3Ø SYS 4Ø94Ø:REM CALL MACHINE LANGUAGE PR
   OGRAM--SAVES KEY CODE IN 4Ø959
4Ø PRINT PEEK(4Ø959),:REM PRINTS 255 UNTI
   L KEY(S) IN SELECTED ROW ARE HIT
5Ø GOTO 3Ø:REM KEEP PRINTING UNTIL MACHIN
   E TURNED OFF (STOP IS DISABLED)
6Ø DATA 169,127,141,Ø,22Ø,173,1,22Ø,141,2
   55,159,96: REM MACHINE LANGUAGE
7Ø REM ML PROGRAM TO SAVE KEY CODE LOADED
    INTO LOCATIONS 4Ø94Ø-4Ø951
```
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Jim Butterfield, Associate Editor

A Bagel Break

Let's walk through an example of programming a complete game, including machine language. We'll make it a simple one: "Bagels," a guessing game that has appeared under other names, including the commercially packaged game, *Master Mind*.

We'll make this one simple, with few frills. We could do it entirely in BASIC, of course; we're using machine language for the practice and for the thrill of seeing the answers come up instantly. You can judge for yourself whether or not machine language handles the job more efficiently.

Ground Rules

We will assume that BASIC will generate the random codes. Yes, you can generate pseudo-random numbers in machine language, too, but we'll shorten the job with BASIC. Once we're into a game, we'll stay entirely in machine language.

The program is written to work on all Commodore machines up to and including the VIC and 64. This means that we need to be careful about memory, since different machines have differently arranged memories. We'll avoid this problem by using the cassette buffer area that is located in the same area in all these machines. And of course, we'll use the built-in Kernal routines that work on all Commodore units: FFD2 to print, FFE4 to get a character.

Planning

We'll need the following work areas:

- A counter which keeps track of the number of guesses (let's put this at $0240 hexadecimal);
- A counter which says how many "exact" matches have been found on this guess (let's use $0241);
- A counter which says how many "inexact" matches have been found (use $0242);
- A counter to keep track of the number of characters typed by the player (we'll use $0243);
- A place to keep the mystery code (four locations from $0244 to $0247 hex);
- A place to put a copy of the mystery code (from $0248 to $204B);
- A place for the user's guess (from $024C to $024F).

Why do we make a copy of the mystery code? Because we will destroy parts of this copy as we test for matches. That way, we will never count the same item twice as a match.

Writing The Program

We lay out a blank piece of paper and try to write the logic. We assume that the BASIC program has placed the mystery code (alphabetic characters from A to F) into hex addresses 0244 to 0247 before it calls upon our program to play the game. Here we go: we'll write a "main routine" first. Although we plan to put it into the cassette buffer (starting at hex 033C), we don't need to write in the addresses – yet.

```
START   LDA #$00
        STA $0240
```

We set our "number of guesses" to zero for starting. Now, on to the next guess:

```
GUESS   INC $0240
        LDA $0240
```

Our guess-number is set one higher, and we bring it into the A register.

```
        CMP #$0A
        BEQ QUIT
```

If we've had nine guesses, we quit here and let BASIC take over. By the way, we don't know exactly where to branch ahead, so we give the branch location a name rather than an address. We'll fill this in soon. In the meantime, if we don't branch, it's time to play:

```
        JSR PLAY
```

This subroutine will do the whole job of receiving one guess from the user and accounting for it. If the user guesses perfectly, the Z flag will be set. In any other case, we'll need to go back:

```
        BNE GUESS
QUIT    RTS
```

Again, we may not know the exact address to which we're looping back at the time we scribble down our first program outline. We'll fill it in later. Sometimes we do this by "hand," and sometimes an assembler program will do it for us. A full-scale assembler will take the "labels" we have used – GUESS, QUIT, and PLAY – calculate their addresses, and make the substitution for us. If we have a smaller assembler, or are assembling by hand, we'll need to write in the addresses. We do this in two columns:

```
        033C  LDA #$00
        033E  STA $0240
GUESS   0341  INC $0240
        0344  LDA $0240
        0347  CMP #$0A
        0349  BEQ $0350
        034B  JSR $0351
        034E  BNE $0341
QUIT    0350  RTS
```

The programmer will quickly learn to convert the program into whatever form his development programs need.

We'll assume this translation (at least in part) and continue with subroutine PLAY. First, we must print the guess number. The binary number in the A register must be converted to ASCII, and printed, together with a following space:

```
0351  PLAY     ORA  #$30
               JSR  $FFD2
               LDA  #$20
               JSR  $FFD2
```

Now, on to the main play. Let's zero the counters, including the player input count:

```
               LDX  #$00
               STX  $0241
               STX  $0242
               STX  $0243
```

Here comes another loop, as we wait for each character to be input. We test each character to make sure that it's a letter from A to F:

```
0366  INLOOP   JSR  $FFE4
               CMP  #$41
               BCC  INLOOP
               CMP  #$47
               BCS  INLOOP
```

We have a legal letter; echo it to the screen and put it to memory.

```
               JSR  $FFD2
               LDX  $0243
               INC  $0243
               STA  $024C,X
```

We must also copy the "secret" code into a work area, so that we can destroy it as we test for matches:

```
               LDA  $0244,X
               STA  $0248,X
```

Have we received all four letters of the guess yet? If not, go back:

```
               CPX  #$03
               BNE  INLOOP
```

Now we may check for exact matches. X is conveniently at three, so we may count it down as we compare:

```
0381  COMPAR   LDA  $0248,X
               CMP  $024C,X
               BNE  SKIP
```

If they don't match, we'll skip the next part. If they do, we must count the match and destroy the values so that we don't use them again:

```
               INC  $0241
               LDA  #$00
               STA  $0248,X
               STA  $024C,X
```

Now, our coding rejoins. We move along to test for the next match:

```
0394  SKIP     DEX
               BPL  COMPAR
```

We have logged any exact matches. Now we must look for the out-of-place matches. We may use X and Y to move through the two values, remembering to skip zeros.

```
               LDY  #$00
0399  RETRY    LDX  #$00
039B  CHECK    LDA  $0248,Y
               BEQ  PASS
               CMP  $024C,X
               BNE  PASS
```

Again, if we see a zero (already counted) or no match, we skip the next bit and go to PASS. Otherwise, we've got a match; we count it and destroy the entry, as before:

```
               INC  $0242
               LDA  #$00
               STA  $0248,Y
               STA  $024C,X
```

Our code comes together again. We have two loops to pick up:

```
03B0  PASS     INX
               CPX  #$04
               BCC  CHECK
               INY
               CPY  #$04
               BCC  RETRY
```

Now we may print the two results, stored in $0241 and $0242. A loop will save a little time and space:

```
               LDX  #$00
03BC  PLOOP    LDA  #$20
               JSR  $FFD2
               LDA  $0241,X
               ORA  #$30
               JSR  $FFD2
               INX
               CPX  #$02
               BCC  PLOOP
```

Now a carriage return to end the line. Finally, we must check for a "correct" solution (exact matches = 4) so that the calling routine will know whether to quit or not:

```
               LDA  #$0D
               JSR  $FFD2
               LDA  $0241
               CMP  #$04
               BNE  PLAY
               RTS
```

That's it for our machine language part; we'll start to put it together next time. ©

Etch-Atari

Roy Glover

This brief review of Atari's GTIA graphics includes a joystick sketch program to draw on screen and examine the visual potential of this powerful computer.

After months of rumors about a display chip that would "someday replace the present one" in the Atari 400 and 800 computers, Atari introduced the GTIA.

CTIA And ANTIC

Before taking a close look at the GTIA itself, let's review Atari's graphics and display system. There are two integrated circuits in the Atari which generate the television display: the CTIA and the ANTIC. The CTIA contains the circuitry which actually displays the data according to the information given to it by the ANTIC, which is a microprocessor dedicated to interpreting the video instructions of the computer program. In other words, your program tells ANTIC what to display, and ANTIC tells CTIA how to display it on the screen.

CTIA offers 14 display modes. Nine of these modes are directly accessible from BASIC, the other five only from machine language. Of the nine BASIC modes, there are three character (text) modes and six graphics (plotted point) modes. GRAPHICS 8, the highest resolution graphics mode, is made up of 320 pixels (picture elements) horizontally and 192 pixels vertically. That is, a GRAPHICS 8 display is composed of 61,440 plotted points (pixels), all restricted to one color and to one of two luminances. Each pixel is either on or off.

Additional Graphics Modes With GTIA

Early in 1982, Atari began replacing the CTIA in 400 and 800 computers with the GTIA chip. The two perform the same tasks and are identical, except that the GTIA offers three additional graphics modes: BASIC modes GRAPHICS 9, 10, and 11.

All three new graphics modes have the same resolution: 80 pixels horizontally and 192 pixels vertically. The pixels are the same height, but four times as wide as pixels in GRAPHICS 8.

GRAPHICS 9 allows each pixel to be displayed with any one of 16 luminances, while all pixels displayed are restricted to the same hue.

GRAPHICS 11 allows each pixel to be displayed with any one of 16 hues, while all pixels displayed are restricted to the same luminance.

GRAPHICS 10 allows each pixel to be displayed with any one of nine hue and luminance combinations.

Using GRAPHICS 9 and 11 is similar to using GRAPHICS 3, 5, and 7. In GRAPHICS 9 the luminance of *each* pixel displayed can be changed by specifying COLOR 0 through COLOR 15. Using SETCOLOR 4,H,0, where H is a number from 0 to 15, the hue of *all* pixels plotted will be changed.

In GRAPHICS 11, COLOR 0 through COLOR 15 specify the hue of *each* pixel displayed, while SETCOLOR 4,0,L, with L being from 0 to 15, changes the luminance of *all* pixels plotted. GRAPHICS 10 requires POKEing values of hue and luminance directly into the nine color registers.

Joystick Sketching

Try the program "Etch-Atari," which enables you to draw on the screen using a joystick. When the program is run, a prompt asks you to select GRAPHICS 9 or 11 and a hue or luminance, respectively. Then a bar appears across the bottom of the screen showing the color you will be drawing with. To change color, press the SELECT key. If you hold it down, the bar will step through the colors. The OPTION key turns the bar off or on. If the bar is off and the SELECT key is pressed, the bar will be turned back on so you can see which color is selected. To clear the screen and start over without returning to the menu, simply press START.

The drawing point starts at the center of the screen. To reposition the point without drawing, press the trigger button while moving the joystick.

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A sample drawing for "Etch-Atari."

This also allows you to trace over and erase points already drawn.

If the joystick is not moved for more than nine minutes, the computer will go into the attract mode (the screen will start changing colors). As long as you are drawing, the attract mode will be defeated.

If you run into the border, a thumping sound will be heard, letting you know that you cannot go any further in that direction. If you feel that the drawing speed is too slow, remove the sound statement at line 90.

If you would like the program to start automatically after loading, save it with SAVE "C:" and reload it with RUN "C:". If you choose CSAVE and CLOAD, line 1000 can be omitted.

Etch-Atari

```
5 GOTO 800
10 GRAPHICS 8:SETCOLOR 4,H,L
15 C=1:COLOR C
20 GOSUB 620
30 X=40:Y=96
40 S=STICK(0):IF S=15 THEN SOUND 0,0
   ,0,0:SOUND 1,0,0,0
50 IF S<15 THEN POKE 77,0:REM Defeat
    attract mode while drawing
60 IF PEEK(53279)=6 THEN GOTO 10:REM
    Check START
70 IF PEEK(53279)=5 THEN GOSUB 600:R
   EM Check SELECT
80 IF PEEK(53279)=3 THEN GOSUB 700:R
   EM Check OPTION
90 SOUND 0,X*RND(0),12,2:SOUND 1,Y*R
   ND(0),12,2
100 IF S=14 THEN Y=Y-1:N=Y+1:M=X
110 IF S=6 THEN X=X+1:Y=Y-1:M=X-1:N=
    Y+1
120 IF S=7 THEN X=X+1:M=X-1:N=Y
130 IF S=5 THEN X=X+1:Y=Y+1:M=X-1:N=
    Y-1
140 IF S=13 THEN Y=Y+1:N=Y-1:M=X
150 IF S=9 THEN X=X-1:Y=Y+1:M=X+1:N=
    Y-1
160 IF S=11 THEN X=X-1:M=X+1:N=Y
170 IF S=10 THEN X=X-1:Y=Y-1:M=X+1:N
    =Y+1
200 IF X>78 THEN X=78:GOSUB 400:REM
    Set plot limits-Sound warning
210 IF X<1 THEN X=1:GOSUB 400
220 IF Y>187 THEN Y=187:GOSUB 400
230 IF Y<1 THEN Y=1:GOSUB 400
240 COLOR C:PLOT X,Y
250 IF STRIG(0)=0 THEN COLOR 0:PLOT
    M,N
260 GOTO 40
400 FOR F=10 TO 0 STEP -1
405 SOUND 2,20*F,12,F
410 NEXT F
415 RETURN
600 C=C+1
610 IF C>15 THEN C=1
620 Z=C
630 COLOR Z
640 PLOT 1,189:DRAWTO 78,189:PLOT 1,
    190:DRAWTO 78,190:PLOT 1,191:DRA
    WTO 78,191
650 FOR W=1 TO 20:NEXT W
660 RETURN
700 IF Z>0 THEN Z=0:GOTO 630
710 IF Z=0 THEN Z=C:GOTO 630
800 GRAPHICS 0
805 POKE 752,1:REM Disable cursor
810 POKE 710,2:REM Background grey
815 ? :?
820 ? "{13 SPACES}ETCH-A-TARI"
825 ? :?
830 ? "START:  Clears screen and pos
    itions"
835 ? "{8 SPACES}cursor at center.":
    ?
840 ? "SELECT: Selects color of next
    "
845 ? "{8 SPACES}point drawn(color o
    f bar"
850 ? "{8 SPACES}at bottom of screen
    ).":?
855 ? "OPTION: Turns color bar off o
    r on.":?
860 ? "Press Trigger button to re-po
    sition"
865 ? "cursor without drawing, and t
    o erase"
870 ? "over points already drawn.":?
875 ? "Select GRAPHICS 9 or 11"
880 ? "and RETURN";:TRAP 885:INPUT G
    :TRAP 40000
885 IF G<>9 AND G<>11 THEN ? "{3 UP}
    {3 DEL LINE}":GOTO 875:REM (3 ES
    C CTRL UP)(3 ESC SHFT DEL)
890 ?
895 IF G=9 THEN ? "Select Hue 0 to 1
    5":? "and RETURN ";:TRAP 900:INP
    UT H:L=0:TRAP 40000
900 IF H<0 OR H>15 THEN ? "{3 UP}
    {3 DEL LINE}":GOTO 895
905 IF G=11 THEN ? "Select Luminance
     0 to 15":? "and RETURN ";:TRAP
    910:INPUT L:H=0:TRAP 40000
910 IF L<0 OR L>15 THEN ? "{3 UP}
    {3 DEL LINE}":GOTO 905
915 ? "{CLEAR}":POSITION 15,11
920 ? "Press START"
925 IF PEEK(53279)=6 THEN GOTO 10:RE
    M Check START
930 GOTO 925
1000 RUN "C:"
```

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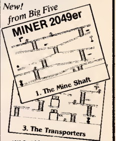

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Input Functions On The VIC

John Ging

The "dynamic keyboard" technique can solve many kinds of programming problems: it's a way to make a program change itself *during execution. One use of dynamic keyboard is illustrated here with a program which lets you enter a function, while a program is RUNning. There's also information on the DEF FN command itself.*

If you use the DEF FN instruction much in your programming, you may have wondered if you can make this instruction "user friendly" by entering the function into the program via an INPUT statement. The obvious way to do this would be to begin your program with:

```
10 INPUT "PROMPT"; A$
```

and to follow this instruction with:

```
20 DEF FNA(X) = A$.
```

Unfortunately, this won't work. If you RUN the program, the computer prints PROMPT on the screen and waits for you to type in the string representing the function. Suppose you type in X↑2+ 7*X and then hit RETURN. The action of the computer is to fill the string variable A$ with the string you just typed in, namely, with X↑2 + 7*X. Then when the program execution continues with instruction 20, the string X↑ 2 + 7*X is substituted for A$ in the DEF FNA(X) = A$ statement. Right? Wrong.

If you follow instruction 20 with:

```
30 PRINT FNA(2)
```

you will get a

```
? TYPE MISMATCH
ERROR IN 30
```

Evidently, the computer has done nothing with the string you just typed in. It still thinks that FNA(X) is literally equal to the string variable *name* A$ rather than equal to the string *represented* by A$.

A Way Out

The only solution would seem to be to LIST instruction 20 and alter the string after "DEF FNA =" by directly typing it in every time you want to change the function represented by FNA(X), and that's not very "user friendly."

Fortunately, on the VIC, there is a way out: the "dynamic keyboard" feature. If you LIST an instruction, alter it from the keyboard, and then hit RETURN while the cursor is on the instruction line, the altered instruction is entered into memory. The trick is to force your program to alter *its own instructions* by causing them to be printed to the screen and RETURNs to be forced over them. This makes it possible for the computer to simulate the INPUT of a function.

The program at the end of this article shows how it works. The essential part of the program is contained in lines 10-40. Line 10 causes

```
F(X) = ?
```

to be printed on the screen and waits for the string representation of the function FNA(X) to be typed in. Line 20 prints

```
60 DEF FNA(X) = "string" (represented by A$)
GO TO 50
```

invisibly (in white) beginning on the second line of the screen. Line 30 POKEs the keyboard buffer with "HOME" and "CURSOR DOWN." Line 40 POKEs the keyboard buffer with two RETURNs, POKEs location 198 with the number of characters in the keyboard buffer (four), and then ENDs the program. When the program ENDs, it skips a line and prints "READY" (also in white) on the screen; then the RETURNs are executed. The execution continues at line 50, which skips down under the INPUT line and returns the character color to the normal blue.

The purpose of the program is to find the area under the graph of the function FNA(X) from X = X1 to X = X2 with N subdivisions (N should be an even number). As an example, RUN the program and type in 4/(1 + X↑2) after the prompt

```
F(X) = ?.
```

Then type in 0 and 1, respectively after the prompts

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X1=?
X2=?
and type in 100 after N=?.

The result will be given by INTEGRAL= , and the answer is a good approximation to π.

Input Functions

```
2 REM:FINDS THE AREA{2 SPACES}UNDER THE
  GRAPH OF A{2 SPACES}FUNCTION FROM X1 T
  O X2WITH N SUBDIVISIONS.
5 PRINT "{CLR}{3 SPACES}INPUT A FUNCTION "
10 PRINT"{HOME}{9 DOWN}":INPUT"F(X)=";A$
20 PRINT"{HOME}{DOWN}{WHT}60 DEFFNA(X)="
   ;A$:PRINT"GOTO 50"
30 POKE 631,19:POKE 632,17
40 FOR I=633 TO 634:POKE I,13:NEXT:POKE
   198,4:END
50 PRINT"{7 DOWN}{BLU}"
70 INPUT"X1=";X1
80 INPUT"X2=";X2
90 INPUT"N=";N
100 D=(X2-X1)/N
110 S=0
120 FOR I=1 TO N-1 STEP 2
130 S=S+FNA(X1+I*D):NEXT:S=S*2
140 FOR I=2 TO N-2 STEP 2
150 S=S+FNA(X1+I*D):NEXT
160 S=D*(2*S+FNA(X1)+FNA(X2))/3
170 PRINT"INTEGRAL=";S
175 POKE 36878,15:POKE 36876,170:FOR I=
    1 TO 200:NEXT:POKE 36876,0
180 PRINT
190 PRINT"TO CONTINUE,HIT ANY{3 SPACES}K
    EY."
200 GET A$:IF A$="" THEN 200
210 GOTO 5
```

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Using DEF FN

A *function* is a BASIC word that takes a number within parentheses, performs some operation on it, and gives you a result. For example, some common functions are INT(X), which removes the fractional part of a number, or ABS(X), which makes negative numbers positive.

With the DEF FN command, you can create your own functions. Here's one way: to round X to the nearest cent you might type in: X=INT(X*100+.5)/100.

If you want to round off in this way many times throughout a program, you could define a function to do it for you. Just type: 10 DEF FNROUND(X)=INT(X*100+.5)/100. Notice that you give it a name, just like you do with variables.

You have just created a function, whose name is ROUND. You can use ROUND just like any other function. From now on, you can round numbers to the nearest cent without having to type in the whole equation. For example, if you type:

PRINT FNROUND(7.3628)

the result will be 7.36. Some other possibilities are:

PROFIT=FNROUND(GROSS) -FNROUND (OVERHEAD)

or

PROFIT=FNROUND(GROSS-OVERHEAD)

You cannot make functions that use strings (words), and you cannot type DEF FN directly like a PRINT; it must be inside a program.

When using ROUND, any number between the parentheses will be used as X in the equation INT(X*100+.5)/100.

If we now write:

20 DEF FNTEST(B)=B*A

B will be whatever number we put between parentheses, and A will have the same value it does everywhere else in the program.

For example:

A=3
PRINT FNTEST(5)

will give 15, since FNTEST will multiply whatever is in the brackets by A.

Apple Bytechanger

Wally Hubbard

Did you think that there's no way to put RETURNs into REM statements? Or into PRINT statements? Or to put backspace characters into REM statements?

This machine language search and replace program opens a universe of options like these. Use your imagination after you type in the BASIC listing. This article also throws some light on how BASIC is stored in your computer.

A machine language program can be stored in your Apple computer three ways: (1) by typing on the keyboard; (2) by loading it from cassette or disk; (3) by LOADing a BASIC program and having it POKE the machine language into place. It's the third method that we'll use here.

When you RUN this program, it will ask you to provide information so that it can set itself up for the particular function you have in mind. Once you have done this, you can LOAD another BASIC program without affecting the machine language program. Then to change the new program, type & and press RETURN. The computer will jump to the machine language program, execute it, and return to BASIC.

Search And Replace

This program will search through your BASIC program until it finds a REM statement, then read the information between REM and the end of the line, and change any control-A's to carriage returns. When it reaches the end of the line (or a colon), it goes on to the next line and continues its search for REM statements until it reaches the end of the BASIC program.

You can change it so that it will look for any other command, and change characters that follow on that line, until the end of the line or the colon is encountered.

For example, say you want to make your REM statements easier to read by inserting carriage returns. When you type the REM statement, type a control-A everywhere you want a carriage return. Then, when you're finished, use the & command to execute the machine language program. You'll see the results when you list your program.

As another example, suppose your printer requires the Escape character to access special functions. It is possible to type your BASIC program with control-E's in place of the Escape character, then later run the machine language program to make a switch.

BASIC Tricks

BASIC uses some space-saving tricks to store a program. For one, it converts commands into tokens. So REM is not stored as the ASCII codes for R, E, and M. Instead, the entire word is converted to the value $B2. (The $ indicates the value is in hexadecimal notation. $B2 is equivalent to 178 in ordinary decimal notation.)

Another trick is using the character that indicates the end of a program line. You would assume (because you hit RETURN to tell the computer you have finished entering a line) that it would store the ASCII code for RETURN, $0D (13). But it doesn't. Instead, it stores $00 (0).

A third trick is the conversion of all line numbers to two bytes. A line number of 1 is stored as $01 00, and a line number of 256 is stored as $00 01. The high-order (more significant) byte is in the second position.

The machine language program puts this information to good use. Every time it encounters $00, it skips over the line number (and two more bytes which hold the location of the next line) to the beginning of the next command sequence. If

it finds a value of $B2, the token for REM, when it is looking for REM statements, it jumps to the subroutine that switches one character for another. If the subroutine encounters a $00, or the ASCII token for ":", it ends and the program starts looking for the next REM statement.

Here's a list of some tokens and ASCII values of interest. You can find a list of ASCII codes used by Applesoft on pages 138 and 139 of the *Applesoft BASIC Programming Manual*. The tokens for the commands can be found on page 121.

Hex	Decimal	Printed As	
$B2	178	REM	(Token)
BA	186	PRINT	(Token)
84	132	INPUT	(Token)
8B	139	IN#	(Token)
8A	138	PR#	(Token)
23	35	#	(ASCII)
01	1	(Control-A)	(ASCII)
0D	13	(RETURN)	(ASCII)

You should know that DOS commands in a BASIC program are not tokenized. In

```
10 PRINT CHR$(4);"PR# 1"
```

PR# is stored as the ASCII equivalents for P, R, and #. Take this into consideration when setting up the machine language program. The token to search for in such a situation is $23, the ASCII code for #.

Changing Switch Without Loader

Let's call the BASIC program listed with this article *Loader* and the machine language program that it produces *Switch*. Once you have run Loader, you can change Switch, without rerunning Loader, using POKE commands.

To change the command token, use POKE 796, (new token).

To change the byte to be replaced, use POKE 815, (new byte).

To change the replacement, use POKE 821, (new byte).

Here's an example. If you want to change all of the control-B's in all of your PRINT statements to control-G's (bell ringers), you must first know that the token for PRINT is 186, that the ASCII byte for control-B is 2, and that the ASCII byte for the bell character is 7. Then enter:

```
] 10 POKE 796,186 : POKE 815,2 : POKE 821,7
```

The equivalent monitor command line is:

```
* 31C:BA N 32F:02 N 335:07
```

(The N allows you to put more than one command on a line.) Then enter & to make the change (or 300G in machine language).

Some Quick Facts About The Program

The machine language program can be placed anywhere in memory. Normally it resides at $300-$350 (768 to 848).

Locations $F9 and $FA (249 and 250) are normally unused by BASIC, DOS, or the monitor, but are used by Switch to keep track of its current point in the BASIC program it is changing.

Switch gets its information for the beginning and end locations of the program from $67 and $68 (103 and 104) and $AF and $B0 (175 and 176), respectively.

The & vector must be set to $300 (768). This is done by Loader.

Bytechanger

```
10  REM

SWITCH LOADER

20  HOME : REM  CLEAR SCREEN
30  PRINT "THIS UTILITY WILL ALLOW YOU
     TO MAKE"
40  PRINT "GLOBAL CHANGES IN YOUR PROGR
     AM.  IT IS"
50  PRINT "SET UP TO CHANGE ALL CTRL-A'
     S IN REM "
60  PRINT "STATEMENTS TO RETURNS."
70  RESTORE : GOSUB 320: REM POKESWITCH
     INTO MEMORY
80  PRINT : INPUT "WOULD YOU LIKE TO CH
     ANGE IT? Y/N ";A$
90  IF  LEFT$ (A$,1) = "N" THEN 280
100  IF  LEFT$ (A$,1) <  > "Y" THEN 20
110  HOME
120  VTAB 10: PRINT "I WANT TO CONVERT
     THIS CHARACTER: ";: GET A$: PRINT
     A$: REM  'GET'
     ALLOWS YOU TO GRAB CARRIAGE
     RETURNS AND ESCAPES
130  PRINT "TO THIS CHARACTER: ";: GET
     B$: PRINT B$
140  PRINT "IN ALL"
150  PRINT "    1 REM"
160  PRINT "    2 PRINT"
170  PRINT "    3 INPUT"
180  PRINT "    4 IN#    (NO DOS)"
190  PRINT "    5 PR#    (NO DOS)"
200  PRINT "    6 #      (DOS IN USE)"
210  PRINT "STATEMENTS.  CHOOSE # ";: GET
     C$: PRINT C$
220  IF  VAL (C$) = 2 THEN  POKE 796,18
     6
230  IF  VAL (C$) = 3 THEN  POKE 796,13
     2
240  IF  VAL (C$) = 4 THEN  POKE 796,13
     9
250  IF  VAL (C$) = 5 THEN  POKE 796,13
     8
260  IF  VAL (C$) = 6 THEN  POKE 796,35
270  POKE 815, ASC (A$): POKE 821, ASC
     (B$): REM  POKE ASCII
     VALUES INTO SWITCH
280  POKE 1013,76: POKE 1014,0: POKE 10
     15,3: REM  POKE IN THE
     VECTOR FOR THE '&' COMMAND
290  PRINT : PRINT "USE '&' TO CONVERT"
300  END
310  REM
```

DATA FOR SWITCH

```
320  FOR A = 768 TO 848: READ B: POKE A
     ,B: NEXT : RETURN
330  DATA 169,0,133,249,165,104,133,250
     ,169,3,24,101,103,144,2,230,250,16
     8,200
340  DATA 208,2,230,250,177,249,240,31,
     169,178,209,249,208,241,200,208,2,
     230,250
350  DATA 177,249,240,16,201,58,240,228
     ,169,1,209,249,208,237,169,13,145,
     249,208
360  DATA 231,162,4,200,208,2,230,250,2
     02,208,248,165,250,197,176,144,200
     ,240,198
370  DATA 196,175,144,194,96
380  REM
     THIS REMARK WAS PRECEDED
     BY A CARRIAGE RETURN AND
     FIVE SPACES ON EACH LINE
```

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Part I

Mixing Graphics Modes On The 64

Sheldon Leemon

It's possible to have several different graphics modes simultaneously on the 64 screen. Program 1 shows you how to divide the display into three zones: high resolution, regular text, and multicolor bitmap mode. Program 2 uses the same utility program, but creates entirely different effects. The screen displays all three text modes: regular, extended background color, and multicolor.

This graphics technique provides you with significant control over what appears on your screen. For example, you can switch modes with simple POKEs. Although there's plenty of technical information here for advanced programmers, the author has provided instructions and example programs which beginners can follow. Everyone can take advantage of these important techniques.

The *Commodore 64 Programmer's Reference Guide* hints that more than one graphics mode may be displayed on the screen at once. When it comes time to explain how it can be done, however, the *Guide* states only that you must set a raster interrupt for the screen line where you want a different type of display to start, set the VIC-II chip for the new mode during that interrupt, and then set up another interrupt to change the mode back a little farther down the display. This explanation might be clear to advanced machine language programmers, but it leaves a lot of others in the dark.

In this tutorial, we'll look at some examples of raster interrupts that can be easily used by BASIC programmers to create split-screen displays and other effects. We'll also discuss, in more detail, how machine language programmers can use the raster interrupt capability.

The Interrupt

The most obvious place to start our discussion is by explaining what an interrupt is. An interrupt is a signal given to the microprocessor (the "brains" of the computer) that tells it to stop executing its machine language program (for example, BASIC itself is a machine language program) and to work on another program for a short time, perhaps only a fraction of a second. After finishing the interrupt program, the computer goes back to executing the main program, just as if there had never been a detour.

There are several ways to cause such an interrupt on the 64. Pressing the RESTORE key causes an interrupt, and if the STOP key is also pressed, the interrupt routine clears the screen and restores the computer to its normal state. There are internal timers on the CIA Input/Output chips that can each generate interrupts. One of these timers is set by the operating system to interrupt every sixtieth of a second, and the interrupt routine that is called is used to check the keyboard and to update the jiffy clock which is used by TI and TI$. In addition, the VIC-II chip can also interrupt normal program execution when one of a number of events related to the graphics display occurs. One of these is called a raster interrupt.

On a normal TV display, a beam of electrons (raster) scans the screen, starting in the top left-hand corner and moving in a straight line to the right, lighting up appropriate parts of the screen line on the way. When it comes to the right edge, the beam moves down a line and starts again from the left. There are 263 such lines that are scanned by the 64 display, 200 of which form the visible screen area. This scan updates the complete screen display 60 times every second.

The VIC-II chip has memory registers that keep track of the line that the raster is scanning at any given moment. Since the line number can be greater than 255, one register is not enough to do the job. Therefore, the part of the number that is less than 256 is kept in location 53266 ($D012 hex), and if bit 7 of location 53265 ($D011) is set to 1, 256 is added to that number to arrive at the correct scan line. Of course, since these numbers change 15,780 times per second, a BASIC program executes far too slowly to read the registers and take effective action based on their contents. Only a machine language program has the speed to accomplish something with a particular raster scan line, and even it may not be quick enough to change the display without some slight, but visible, disruption.

The raster registers have two functions. When read, they tell what line is presently being scanned. But when written to, they designate a particular scan line as the place where a raster interrupt will occur. If the raster interrupt is enabled, the interrupt program will be executed at the exact moment that the raster beam reaches that line. This allows the user to reset any of the VIC-II registers at any point in the display and thus change character sets, background color, or graphics mode for only a part of the screen display.

Setting up a raster interrupt program is admittedly not a job for a beginning programmer, but with the following step-by-step explanation, most machine language programmers should be able to write such a routine. Those with no machine language experience should read the explanation in order to get a general idea of what is taking place. Afterwards, we'll see how to use the example interrupt routine even if you don't know anything about machine language programming.

Writing A Raster Interrupt

When you have finished writing the machine language routine that you want the interrupt to execute, the steps required to set up the raster interrupt are:

1. Set the interrupt disable flag in the status register with an SEI instruction. This will disable all interrupts and prevent the system from crashing while you are changing the interrupt vectors.

2. Enable the raster interrupt. This is done by setting bit 0 of the VIC-II chip interrupt enable register at location 53274 ($D01A) to 1.

3. Indicate the scan line on which you want the interrupt to occur by writing to the raster registers. Don't forget that this is a 9-bit value, and you must set both the low byte (in location 53264) and the high bit (in the register at 53265) in order to insure that the interrupt will start at the scan line you want it to, and not 256 lines earlier or later.

4. Let the computer know where the machine language routine that you want the interrupt to execute starts. This is done by placing the address in the interrupt vector at locations 788-789 ($314-$315). This address is split into two parts, a low byte and a high byte, with the low byte stored at 788. To calculate the two values for a given address AD, you may use the formula HIBYTE = INT(AD/256) and LOWBYTE = AD-(HIBYTE*256). The value LOWBYTE would go into location 788, and the value HIBYTE would go into location 789.

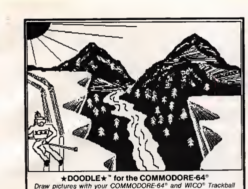
5. Re-enable interrupts with a CLI instruction, which clears the interrupt disable flag on the status register.

When the computer is first turned on, the interrupt vector is set to point to the normal hardware timer interrupt routine, the one that advances the jiffy clock and reads the keyboard. Since this interrupt routine uses the same vector as the raster interrupt routine, it is best to turn off the hardware timer interrupt by putting a value of 127 in location 56333. If you want the keyboard and jiffy clock to function normally while your interrupt is enabled, you must preserve the contents of locations 788 and 789 before you change them to point to your new routine. Then you must have your interrupt routine jump to the old interrupt routine exactly once per screen refresh (every sixtieth of a second).

Another thing that you should keep in mind is that at least two raster interrupts are required if you want to change only a part of the screen. The interrupt routine must not only change the display, but it must also set up another raster interrupt that will change it back.

Program 1 is a BASIC program that uses a raster-scan interrupt to divide the display into three sections. The first 80 scan lines are in high-resolution bitmap mode, the next 40 are regular text, and the last 80 are in multicolor bitmap mode. The screen will split this way as soon as a SYS to the routine that turns on the interrupt occurs, and the display will stay split even after the program ends. Only if you hit the STOP and RESTORE keys together will the display return to normal.

Program 2 shows how a completely different split screen can be set up using the same machine language program. The DATA statements for the interrupt routine are the same as for Program 1, except for the tables starting at line 49264. By changing these tables, we now have a display that shows all three text modes: regular, extended background color, and multicolor. Upper- and lowercase text are mixed, and each area has a



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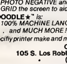

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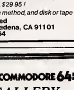

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different background color. This program also shows that you can change the table values during a program by POKEing the new value into the memory location where those table values are stored. In that way, you can, for example, change the background color of any of the screen parts while the program is running.

Once you know how to use all the graphics features that the VIC-II chip makes available, the sample interrupt program should enable you to combine several different display modes on a single screen, so that you can take maximum advantage of the 64's graphics power.

Program 1: Text With Graphics

```
10 FOR I=49152 TO 49278: READ A:POKE I,A
   :NEXT:SYS12*4096
20 PRINT CHR$(147):FOR I=Ø TO 8:PRINT:NE
   XT
30 PRINT"THE TOP AREA IS HIGH-RES BIT MA
   P MODE"
40 PRINT:PRINT"THE MIDDLE AREA IS ORDINA
   RY TEXT "
50 PRINT:PRINT"THE BOTTOM AREA IS MULTI-
   COLOR BIT MAP"
60 FORG=1024 TO 1383:POKEG,114:NEXT:FORG
   =1384 TO 1423:POKE G,6:NEXT
70 FORG=1664 TO 2023:POKEG,234:NEXT
80 FORG=55936TO56295:POKEG,13:NEXT
90 FOR I=8192 TO 11391:POKE I,Ø:POKE I+4
   8ØØ,Ø:NEXT
100 BASE=2*4096:BK=49267
110 H=40:C=Ø:FORX=ØTO319:GOSUB150:NEXT
120 H=160:C=Ø:FORX=ØTO319STEP2:GOSUB150:
    NEXT:C=40:FORX=1TO319STEP2:GOSUB150:
    NEXT
130 C=80:FOR X=Ø TO 319 STEP2:W=Ø:GOSUB1
    5Ø:W=1:GOSUB15Ø:NEXT
140 GOTO 140
150 Y=INT(H+20*SIN(X/10+C)):CH=INT(X/8):
    RO=INT(Y/8):LN=YAND7
160 BY=BASE+RO*320+8*CH+LN:BI=ABS(7-(XAN
    D7)-W)
170 POKEBY,PEEK(BY)OR(2↑BI):RETURN
49152 DATA 12Ø, 169, 127, 141, 13, 22Ø
49158 DATA 169, 1, 141, 26, 2Ø8, 169
49164 DATA 3, 133, 251, 173, 112, 192
49170 DATA 141, 18, 2Ø8, 169, 24, 141
49176 DATA 17, 2Ø8, 173, 2Ø, 3, 141
49182 DATA 11Ø, 192, 173, 21, 3, 141
49188 DATA 111, 192, 169, 5Ø, 141, 2Ø
49194 DATA 3, 169, 192, 141, 21, 3
49200 DATA 88, 96, 173, 25, 2Ø8, 141
49206 DATA 25, 2Ø8, 41, 1, 24Ø, 43
49212 DATA 198, 251, 16, 4, 169, 2
49218 DATA 133, 251, 166, 251, 189, 115
49224 DATA 192, 141, 33, 2Ø8, 189, 118
49230 DATA 192, 141, 17, 2Ø8, 189, 121
49236 DATA 192, 141, 22, 2Ø8, 189, 124
49242 DATA 192, 141, 24, 2Ø8, 189, 112
49248 DATA 192, 141, 18, 2Ø8, 138, 24Ø
49254 DATA 6, 1Ø4, 168, 1Ø4, 17Ø, 1Ø4
49260 DATA 64, 76, 49, 234
49264 DATA 49, 17Ø, 129 :REM SCAN LINES
49267 DATA Ø, 6, Ø:REM BACKGROUND COLOR
49270 DATA 59, 27,59:REM CONTROL REG. 1
49273 DATA 24, 8, 8:REM CONTROL REG. 2
49276 DATA 24, 2Ø, 24:REM MEMORY CONTROL
```

Program 2: The Three Text Modes

```
10 FOR I=49152 TO 49278: READ A:POKE I,A
   :NEXT:SYS12*4096
20 PRINTCHR$(147)CHR$(5):POKE 53280,Ø
30 POKE 53280,Ø:POKE 53282,6:POKE 53283,
   5:POKE 53284,4
40 PRINT:PRINT"THIS IS MULTI-COLOR TEXT
   MODE"
50 PRINT:PRINT"FOUR-COLOR CHARACTERS ARE
    HARD TO READ"
60 PRINT:PRINT CHR$(15Ø)"ABCDEFGHIJKLMNO
   PQRSTUVWXYZ123456789Ø"
70 PRINT:PRINT:PRINT:PRINT CHR$(28)"THIS
    IS NORMAL TEXT MODE..."
80 PRINT:PRINT"NOTHING FANCY GOING ON HE
   RE":PRINT:PRINT:PRINT
90 PRINTCHR$(144)"{6 SPACES}EX{RVS}TE
   {OFF}ND{RVS}ED{OFF} BA{RVS}CK{OFF}GR
   {RVS}OU{OFF}ND{RVS} C{OFF}OL{RVS}OR
   {OFF} MO{RVS}DE{OFF}{UP}"
100 PRINT:PRINT"LETS YOU USE DIFFERENT B
    ACKGROUND COLORS"
110 PRINT "{RVS}LETS YOU USE DIFFERENT B
    ACKGROUND COLORS"
120 PRINT"LETS{SHIFT-SPACE}YOU
    {SHIFT-SPACE}USE{SHIFT-SPACE}DIFFERE
    NT{SHIFT-SPACE}BACKGROUND
    {SHIFT-SPACE}COLORS"
130 PRINT "{RVS}LETS{SHIFT-SPACE}YOU
    {SHIFT-SPACE}USE{SHIFT-SPACE}DIFFERE
    NT{SHIFT-SPACE}BACKGROUND
    {SHIFT-SPACE}COLORS";
140 FORS=ØTO3ØØØ:NEXT
150 FORS=49267TO49269:POKES,RND(1)*16:FO
    R I=1 TO 2ØØØ:NEXT I,S:GOTO 14Ø
49152 DATA 12Ø, 169, 127, 141, 13, 22Ø
49158 DATA 169, 1, 141, 26, 2Ø8, 169
49164 DATA 3, 133, 251, 173, 112, 192
49170 DATA 141, 18, 2Ø8, 169, 24, 141
49176 DATA 17, 2Ø8, 173, 2Ø, 3, 141
49182 DATA 11Ø, 192, 173, 21, 3, 141
49188 DATA 111, 192, 169, 5Ø, 141, 2Ø
49194 DATA 3, 169, 192, 141, 21, 3
49200 DATA 88, 96, 173, 25, 2Ø8, 141
49206 DATA 25, 2Ø8, 41, 1, 24Ø, 43
49212 DATA 198, 251, 16, 4, 169, 2
49218 DATA 133, 251, 166, 251, 189, 115
49224 DATA 192, 141, 33, 2Ø8, 189, 118
49230 DATA 192, 141, 17, 2Ø8, 189, 121
49236 DATA 192, 141, 22, 2Ø8, 189, 124
49242 DATA 192, 141, 24, 2Ø8, 189, 112
49248 DATA 192, 141, 18, 2Ø8, 138, 24Ø
49254 DATA 6, 1Ø4, 168, 1Ø4, 17Ø, 1Ø4
49260 DATA 64, 76, 49, 234
49264 DATA 49, 177, 113 :REM SCAN LINES
49267 DATA 2, 7, 6:REM BACKGROUND COLOR
49270 DATA 91, 27,27:REM CONTROL REG. 1
49273 DATA 8, 8, 24:REM CONTROL REG. 2
49276 DATA 2Ø, 22, 2Ø:REM MEMORY CONTROL
```

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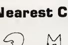

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A Fig-Forth Utility

Jurgen Pfeifer

There are several versions of Forth. The most popular is the Implementation of the Forth-Interest-Group (FIG), the well known fig-Forth.. But there exists an improvement, the 79-Standard Forth, which is very close to fig-Forth.

The 79-Standard describes a very useful word, which doesn't exist in fig-Forth. It is the word "roll." The Forth stack notation for roll is:

roll n–

This word extracts the nth stack value to the top of stack, not counting n itself, moving the remaining values into the vacated position. n must be strictly positive.

Examples: 3 roll = rot (a fig-word).
1 roll = no operation.

The screens here contain a low-level definition of "roll" for a 6502 fig-Forth, using the Forth 6502 macroassembler.

As an application, the screens contain the definition of the signed double-integer multiplication operator "d*". Try to define it without roll!

```
SCR # 106
( ROLL                                              JPF   JUL82 )
CODE ROLL ( N --- )
  1 # LDA, SETUP JSR, XSAVE STX, N LDA, SEC, 1 # SBC, CS
  IF, 0= NOT IF,
               TAY, .A ASL, CLC, XSAVE ADC, TAX,
               BOT LDA, PHA, BOT 1+ LDA, PHA,
               BEGIN, DEX, DEX,
                      BOT LDA, SEC STA,
                      BOT 1+ LDA, SEC 1+ STA,
                      DEY, 0=
               UNTIL, PLA, PUT JMP,
            THEN,
  THEN, NEXT JMP, END-CODE
( ROLL : EXTRACT THE N-TH STACK VALUE TO THE TOP OF STACK, NOT
        COUNTING N ITSELF, MOVING THE REMAINING VALUES INTO THE
        VACATED POSITION. N>0 )

SCR # 107
( ROLL APPLICATION                                  JPF   JUL82 )
: PICK 2* SP@ + @ ;
  ( N1 --- N2 : RETURN THE CONTENTS OF THE N1-TH STACK VALUE,
                NOT COUNTING N1 ITSELF. N>0 )

: 2SWAP ROT >R ROT R> ;
  ( D1 D2 --- D2 D1 : EXCHANGE THE TOP TWO DOUBLE NUMBERS
                      ON THE STACK. )

: D* OVER 5 PICK U* 6 ROLL 4 ROLL * + 2SWAP * + ;
  ( D1 D2 --- D3 : LEAVES THE ARITHMETIC PRODUCT OF THE
                   DOUBLE PRECISION INTEGERS D1 AND D2 )
```

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Banish Atari INPUT Statements

Jim Faryar

If you use BASIC's INPUT statement, you relinquish control to the computer. Here is a subroutine that lets you avoid INPUT by using the Atari's string-handling.

Here's an enhanced No-INPUT-Statement Input subroutine for the Atari. It is a useful application of Atari's string-handling method. We use POS to keep track of the relative position of the cursor within the string INP$. Then, we assign the character typed in by the user, CHR$(KEY), to the input string INP$ at position (POS,POS), replacing anything in that position (line 47).

Cursor right and left keys result in a change in POS, but no character assigned to INP$. The BACK-S key results in a change in POS, as well as a space assigned to replace the character in the new position INP$(POS,POS). Additional control is provided by keeping POS within the space ("mask") allowed for input, and by allowing characters of only type T$ (see below) to be typed in.

The subroutine:

- Supports the insert, delete, and right and left cursor keys, as well as the BACK-S key.
- Inhibits cursor movement outside the input "mask" to protect the screen display.
- Controls the length of the user's input.
- Controls the range of characters the user may input.
- Beeps when the user attempts an unauthorized keystroke.

Type in the program.

Lines 10-17 support the use of the INSERT key.
Lines 18-27 support the use of the DELETE key.
Lines 28-33 support the use of the CURSOR-RIGHT key.
Lines 34-42 support the use of the CURSOR-LEFT and BACK-S keys.
Lines 43-49 restrict the characters that may be input.
Lines 100-300 are a demonstration.

Be careful to include the semicolon that ends most of the PRINT statements. Run the program: try any keystrokes you wish and see the result. I could not disable the BREAK or the SYSTEM RESET keys (can anyone show me how?).

To use the subroutine in your own programs, simply:

1. Start your program at line 100.

2. PRINT your input prompt, ending it with a semicolon.

3. LET L1 = length you will allow for input.

4. LET T$ = type of characters you will allow:
"A" – converts all lowercase letters input to uppercase.
"9" – allows numbers only.
"X" – allows all characters.
(You can add to and modify these categories, by altering lines 44-45.)

5. GOSUB 5.

6. INP$ will contain the value input. You can set it equal to your own variable, for example:

NAME$ = INP$
NUM$ = INP$: NUM = VAL(NUM$).

Note that, for numeric variables, I do not take VAL(INP$), but VAL of an intermediate variable NUM$: because VAL(INP$) adversely affects the use of INP$ in subsequent calls to the subroutine. I don't know why this happens.

7. Remember not to use the variables I1, L1, T$, KEY, INP$, and POS anywhere else in your program.

INPUT Mask

```
1 REM INPUT MASK
2 OPEN #1,4,0,"K:"
3 DIM INP$(37),T$(1)
4 GOTO 100
5 POS=1
6 INP$="":IF T$="9" THEN INP$="0"
7 GET #1,KEY
8 IF KEY=155 THEN RETURN
9 IF (KEY>31) AND (KEY<125) THEN 43
10 IF KEY<>255 THEN 18
11 IF LEN(INP$)=L1 THEN 50
12 PRINT CHR$(255);
13 FOR I1=LEN(INP$)+1 TO POS+1 STEP -1
14 INP$(I1,I1)=INP$(I1-1,I1-1)
15 NEXT I1
16 INP$(POS,POS)=" "
17 GOTO 7
18 IF KEY<>254 THEN 28
19 IF POS>LEN(INP$) THEN 50
20 PRINT CHR$(254);
21 IF LEN(INP$)=1 THEN 5
22 IF POS=LEN(INP$) THEN INP$=INP$(1,POS-1):GOTO 7
23 FOR I1=POS TO LEN(INP$)-1
24 INP$(I1,I1)=INP$(I1+1,I1+1)
25 NEXT I1
26 INP$=INP$(1,I1-1)
27 GOTO 7
```

```
28 IF (KEY=30) OR (KEY=126) THEN 34
29 IF KEY<>31 THEN 50
30 IF POS>=L1 THEN 50
31 PRINT CHR$(31);:POS=POS+1
32 IF POS-LEN(INP$)>1 THEN INP$(POS-
   1,POS-1)=" "
33 GOTO 7
34 IF POS<=1 THEN 50
35 IF POS=LEN(INP$) THEN IF INP$(POS
   ,POS)=" " THEN INP$=INP$(1,POS-1)
36 POS=POS-1
37 IF KEY=30 THEN PRINT CHR$(30);:GO
   TO 7
38 PRINT CHR$(126);
39 IF LEN(INP$)=1 THEN 5
40 IF POS=LEN(INP$) THEN INP$=INP$(1
   ,POS-1):GOTO 7
41 INP$(POS,POS)=" "
42 GOTO 7
43 IF POS>L1 THEN 50
44 IF (T$="A") AND (KEY>96) THEN KEY
   =KEY-32
45 IF (T$="9") AND ((KEY<48) OR (KEY
   >57)) THEN 50
46 PRINT CHR$(KEY);
47 INP$(POS,POS)=CHR$(KEY)
48 POS=POS+1
49 GOTO 7
50 PRINT CHR$(253);:GOTO 7
60 REM
70 REM
100 DIM NAME$(20),NUM$(12)
110 PRINT CHR$(125)
120 POSITION 4,2
130 PRINT "NAME: ";
140 L1=20:T$="A":GOSUB 5
150 NAME$=INP$
160 POSITION 4,4
170 PRINT "NUMBER: ";
180 L1=4:T$="9":GOSUB 5
190 NUM$=INP$:NUM=VAL(NUM$)
200 POSITION 4,6
210 PRINT "Is ALL the above correct?
   ";
220 L1=3:T$="A":GOSUB 5
230 IF ASC(INP$)<>89 THEN 110
240 POSITION 4,12
250 PRINT NAME$,LEN(NAME$),NUM,ASC(I
   NP$)
300 END
```

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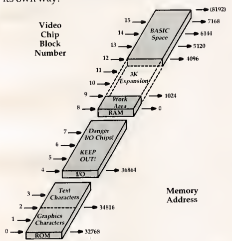
Part IV

Visiting The VIC-20 Video

Jim Butterfield, Associate Editor

In which the traveller finds that the highest resolutions can be achieved by setting his sights a little lower.

We've spent some time viewing the world (or at least memory) from a video chip's-eye view, and we've noted that the video chip sees memory in its own way:



How the video chip sees memory.

We've muddled with the character set, both built-in and home brewed. But we haven't seemed to deal with achieving that mystic goal – high resolution screen control.

We've dealt with custom characters. And as Glinda the Good Witch could have said to Dorothy, "If you had known their powers, you could have done it the very first day." In other words, we've been looking at high resolution all along without recognizing it.

Here's the trick: if every position on the screen contained a different character, and if we can define any character at will, we can define any spot on the screen as we wish.

Filling In

Mechanically, we do it this way: the first cell on the screen will contain character zero; the next will contain character one; and so on. To change the upper-leftmost pixel on the screen, we modify the upper-left pixel of character zero, and the screen immediately shows the change.

This is a change from our usual use of screen and character set. Our screen memory is now totally fixed and must not change. Normal printout and things like scrolling must stop. The characters, on the other hand, are now completely variable, with pixels turning on and off according to what the picture needs.

Wait – there's a problem. It seems that the screen has room for 506 characters; yet we know that we can make only 256 individual characters. Something doesn't fit. How can we resolve this problem?

There are two ways. One is to use "double characters" – the jumbo-sized characters that we get when we POKE an odd number into address 36867. Each of our 256 characters now occupies twice the space on the screen, so that we can cover the screen easily. The character set table now becomes huge, of course: each character takes 16 bytes to describe, making the whole table up to 4096 bytes long.

Since we're trying to describe things you can achieve in an unexpanded VIC, this becomes impractical – it's hard to take 4K away from a machine that has only 3.5K available to start with. On a machine with memory expansion, however, this is quite practical; read on, for we'll use tricks on the small machine that will come in handy even on the big ones.

The other method is this: cut the size of the screen so that it contains only 256 characters or less. We can store the number of columns and

rows we want into 36866 and 36867. POKE 36866,16 will set 16 columns; and POKE 36867,32 will set 16 rows (we must multiply the number by two here). How many characters can we store? 256 – and that number may sound familiar by now.

By the way, BASIC won't know how to cope with the peculiar row and column counts if you do this as a direct command, so be prepared for an odd-looking screen. Neatness fanatics will want to center the remaining display by appropriate POKEs to 36864 and 36865, but I'll leave this as an exercise for you.

Diving In

Enough of this abstract theory. Let's dive into a program to prove that even the humble minimum VIC can do high resolution graphics.

```
100 POKE 56,22:CLR  (Drop top of BASIC)
110 POKE 36869,222  (Relocate screen...)
120 POKE 36866,144  (and character set)
```

Note that the above line sets the screen to a half-block (128) and sets up 16 columns instead of the normal 22 (128 plus 16 gives 144). We may as well go ahead and change the rows:

```
130 POKE 36867,32  (16 rows times 2)
200 FOR J=6144 TO 8191
210 POKE J,0:NEXT J
```

We've cleared the entire character set to zero (all pixels off). Now let's set up the screen with character zero in the first slot, etc.:

```
300 FOR J=0 TO 255
310 POKE J+5632,J
320 NEXT J
```

Let's set all characters to color black:

```
330 FOR J=37888 TO 38911
340 POKE J,0:NEXT J
```

Our screen is now ready. Serious graphics takes quite a bit of math (dividing by 16 to find the row and column; dividing by 8 for the pixel position), but we'll substitute a little simple coding to draw a triangle:

```
400 FOR J=6792 TO 6816 STEP 8
410 POKE J,255  (horizontal line)
420 NEXT J
500 FOR J=6280 TO 6664 STEP 128
510 FOR K=J TO J+7
520 POKE K,128  (vertical line)
530 NEXT K,J
600 FOR J=6280 TO 6704 STEP 136
610 X=128  (leftmost pixel)
620 FOR K=J TO J+7
630 POKE K,PEEK(K) OR X
640 X=X/2  (move pixel right)
650 NEXT K,J
700 GOTO 700
```

The program is now complete. It will wait in a loop at line 700 until you press RUN/STOP. When you do so, a number of odd things will happen. The computer will try to print the word READY into screen memory, but screen memory is intended for a different usage now, and all that will result is screen "clutter."

Bring everything back to sanity by holding down RUN/STOP and hitting the RESTORE key.

Extra Ideas

Effective graphics calls for the use of a fair bit of mathematics. To place (or clear) a pixel, you need to find the row and column by dividing the X and Y coordinates by the appropriate scaling factor. You need to change this to a screen character number by multiplying the row number by the total number of columns and then adding the column number. Multiply this by eight, and you'll get the position where the character is located within the character set. Now we must go for the pixels within this character: the bits within a byte are pixels "across" and the eight consecutive bytes are pixels "down." Now you know why people buy a Super Expander – to save them from the math.

Even when you have plenty of memory available, which allows you to use double characters and get lots of pixels on the screen, it's usual to "trim" the screen a little. The normal 22 columns by 23 rows are usually trimmed back to 20 columns by 20 rows (actually ten rows of double characters). This does two things: it makes the arithmetic a little easier, and it drops the memory requirements from 4096 bytes for a full deck down to only 3200 bytes. This, in turn, gives us space to pack screen memory into the same 4K block. That's handy, because we cannot be sure that the video chip will have access to any more than 4K of RAM. BASIC, of course, will long since have been moved to occupy memory from 8192 and up.

If you want to add text to the high resolution display, it's a snap. Just copy the characters you want from the Character Set ROM and transfer them to the appropriate character slots on the screen. Of course, you would have thought of that yourself if I hadn't just told you.

Don't forget that you can POKE appropriate values into 36864 and 36865 to center the graphics neatly. Our example looked a little lopsided; try your hand at making it neater.

High resolution is there and waiting. Yes, you can do it on a small screen PET.

There's a good bit of math needed. You may find this a challenge: after all, isn't that what a computer does best?

Even if the mathematics befogs your mind and causes you to go out and buy a Super Expander, you'll have learned a few new things. First, the Super Expander doesn't make graphics possible – they were there all the time – it just makes them easier. Second, you'll have a better idea of what's going on inside your marvellous VIC computer.

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PROGRAMS FOR THE COMMODORE 64 AND VIC 20

VICplot

Gerald Chick

This utility draws or erases points on a 64 x 64 grid. The program also lets you examine a point to determine its previous status. Using the example program, you can get a feel for the uses of this short, but effective, programming tool. If you LOAD a program in from cassette, you'll need to re-READ the DATA of VICplot back into the cassette buffer (see lines 1399-1420 and 1510-1560). For the VIC, expanded by 3 or 8K of memory.

"VICplot" is a simple utility for the VIC-20 designed to plot or erase points on a 64 x 64 grid. VICplot's 83-byte program accomplishes three important functions: it allows plotting, erasure, and indicates a point's previous condition.

Functions to draw, erase, or examine a point (similar to Super Expander commands POINT c,x,y and RDOT(x,y)) are included in VICplot. The last function is particularly important. Quite often you will want to know whether a point was lit or not. The sample program uses this function to gather data.

Protecting The Character Set

The character set which makes up the grid is stored in 2K of RAM beginning at 5120 ($1400). This set must be established by BASIC. VICplot is placed in the cassette buffer, so only the character set need be protected from BASIC. If you are using 3K or less expansion, type:

POKE 56,20 :POKE 52,20 :POKE 55,0

With 8K of added RAM, you will have to type:

POKE 44,28 :POKE 7168,0

before you load the program. This sets the start of BASIC above the character set.

The pointer to character memory must also be reset: POKE 36869, 205 for 8K expansion; POKE with 253 for less memory. The sample program has a subroutine at 1400 to load VICplot and draw the screen. Once this is finished, VICplot is ready to use. A few precautions are in order, though.

First, there is no error detection. A too large Y coordinate will plot in the wrong column. Worse than that, a too large X coordinate will be placed *beyond* the matrix, possibly in BASIC or on the screen. A value of 128 for X will cause a point to appear in your BASIC program around location 9200. Second, don't be surprised at the size of the dots. They are actually two pixels square.

Plotting Points With A Sample Program

To access VICplot, the X and Y coordinates should be placed in locations 251 and 252, respectively. To plot this point, place a one in location 253. To erase, place a zero there. Now call VICplot with SYS 832. *Voilà!* Location 251 now holds the status flag. It can be read with

F= -(PEEK (251) = 0).

If F = 1 then the point was lit previously. A zero indicates it was dark.

A point can be lit in one of three colors (character, border, or auxiliary) set by the user. The color used is determined by the following table, which shows the value for each color. The data for this table is in line 1500 of the sample program.

The sample program is a good demonstration of how VICplot works. Two areas are selected, and 4000 random points are plotted on each. If a chosen point is already lit, a counter is incremented. Ten samples are taken of this count, and a bar graph is drawn to compare each trial. The bars are numbered, and the graph is scaled by hundreds.

The program is written for the 8K expander. To work in less memory, the POKEs for screen and color will have to be changed. The many REMarks should help you understand all the elements of this handy program.

VICplot Color Table

COLOR:	Screen	Border	Char.	Aux.
828	0	1	2	3
829	0	4	8	12
830	0	16	32	48
831	0	64	128	192
033C	00	01	02	03
033D	00	04	08	0C
033E	00	10	20	30
033F	00	40	80	C0

VICplot

```
1 REM GRAPH DEMO USING{10 SPACES}VICPLOT
  .
4 REM ----------------
5 REM THIS PROGRAM WRITTEN FOR 8K EXPAND
  ER
6 REM ----------------
10 DIMR(1,11)
15 GOSUB1400:GOTO100
19 REM USE: IFX>63ORY>63THENRETURN FOR E
   RROR PROTECT AT LINE 20 IF NECESSARY
20 POKE251,X:POKE252,Y:POKE253,E
30 SYS832
```

```
40 F=-(PEEK(251)=Ø)
50 RETURN
99 REM DATA COLLECTION{7 SPACES}LOOP
100 FORJ=ØTO1:POKE36878,PEEK(36878)AND15OR(16*(2+3*J)):REM SET AUX. COLOR
110 A=1:FORI=1TO4ØØØ
120 X=INT(RND(1)*(32*(2-J)))
130 Y=INT(RND(1)*(32*(2-J)))
140 E=1:GOSUB2Ø
150 IFFTHENR(J,A)=R(J,A)+1:REM COUNT REPLOT
160 IFI/4ØØ=INT(I/4ØØ)THENA=A+1:R(J,A)=R(J,A-1):REM NEXT SAMPLE
170 NEXTI
180 FORT=1TO1ØØØ:NEXT
190 GOSUB149Ø:NEXTJ
195 REM DISPLAY DATA
200 CM=5364:CL=38Ø45:CR=33152:L=Ø
209 REM TRANSFER CHAR DATA FROM ROM TO CHAR MATRIX
210 FORI=1TO1Ø:POKECL+I,6:IFI=1ØTHENL=-8Ø
220 FORJ=ØTO7
230 A=PEEK(CR+J+8*I+L):POKECM+J,A
240 NEXTJ
250 POKECM-4,255:CM=CM+128
260 NEXTI
270 CM=CM-6:CL=CL+I
279 REM DRAW Y SCALING OF GRAPH
280 FORI=-11ØTOØSTEP4:POKECM+I,24Ø:FORJ=1TO3:POKECM+I+J,128:NEXT
285 POKECL+INT(I/16)*22,6:NEXT
289 REM SET RIGHT OF EACH CHARACTER TO PLOT IN SCREEN COLOR, SET AUX. COL TO RED
290 POKE83Ø,8:POKE831,2:POKE36878,PEEK(36878)AND15OR32
300 X1=1:Y1=55:E=1
309 REM DRAW 8ARS
310 FORI=1TO1Ø:X1=X1+4
320 FORJ=ØTO1:REM LOOP TO GRAPH 8OTH SAMPLES
330 X=X1+J:A=INT(R(J,I)/5Ø):IFA>54THENA=55
340 IFA=ØTHEN38Ø
350 FORY=Y1-A+1TOY1
360 GOSUB2Ø
370 NEXTY
380 NEXTJ,I
390 GOTO39Ø
999 END
1399 REM POKE VICPLOT INTO CASS. BUFFER
1400 FORX=828 TO91Ø
1410 READA:POKEX,A
1420 NEXT
1429 REM PUT CHARACTERS ON SCREEN
1430 PRINT"{CLR}":FORX=ØTO15
1440 FORY=ØTO7
1450 POKE4Ø99+X+22*Y,8*X+Y:REM7683 FOR 3K
1460 POKE37891+X+22*Y,13:REM 384Ø3 FOR 3K
1470 NEXTY,X
1479 REM SET CHAR POINTER TO RAM AND SET DBL HEIGHT CHARACTERS
1480 POKE36869,2Ø5:POKE36867,PEEK(36867)AND128OR25:REM 253 FOR 3K
1489 REM CLEAR CHARACTER MATRIX
1490 FORI=512ØTO7168:POKEI,Ø:NEXT:RETURN
1495 REM DATA FOR COLOR TA8LE OF VICPLOT
1500 DATA192,48,12,3
1505 REM * * * * *
1509 REM DATA FOR VICPLOT
1510 DATA169,Ø,133,1,165,251,74,74,74,133,254
1520 DATA144,4,169,128,133,1,165,254,24,1Ø5,2Ø
1530 DATA133,2,165,252,1Ø,168,165,251,41,3
1540 DATA17Ø,169,Ø,133,251,197,253,24Ø,17,189,6Ø,3
1550 DATA17,1,2Ø9,1,24Ø,4,133,251,145,1,2ØØ,145,1,96
1560 DATA189,6Ø,3,133,254,17,1,2Ø9,1,24Ø,2,133,251,229,254,145,1,2ØØ,145,1,96
1600 TO USE VICPLOT IN YOUR OWN PROGRAMS
1610 COPY LINES 14ØØ-156Ø.
1620 GOSUB14ØØ TO POKE VICPLOT AND DRAW MATRIX.
1630 GOSUB149Ø TO CLEAR MATRIX.
1640 USE THE SUBROUTINE AT LINE 2Ø TO
1650 CALL VICPLOT
1660 NOTE: YOU MAY WANT TO PREVENT POINTS OVER 63 FROM BEING PLOTTED.
```

©

VIC Display Messages

Rick Kelm

"Display Messages" is a program which will do just that on the VIC color screen. The message appears on the right, one character at a time, moves leftward across the screen, and then vanishes. The program can be used to display business hours, holiday greetings, information, directions, and so forth. Passersby can't resist reading the messages.

Program 1 can be incorporated easily as a subroutine in games and other programs where an eye-catcher is needed. It is a demonstration and you can quickly substitute a message of your own by changing the DATA statements at the end of the program. Be sure to type the program exactly as shown. After you have the program running, try changing the number of cursors-left in line 50 and see what happens. Try changing the TAB(20) to another number. This should give you some idea of how the program moves your message.

The key is line 50, with the proper number of tabs and cursors-left. Most important is the CHR$(20), which actually causes the movement by removing a space at column 2, line 11. That makes everything move one space to the left.

Note: The VIC will not print some punctuation marks – including commas and colons – from the DATA statements unless they are enclosed in quotation marks. Program 1 is useful for short, reusable messages. These can be stored easily on tape.

However, long messages require very long DATA statements which are time-consuming and awkward. Program 2 allows direct typing of your message without the use of DATA statements. The program also offers a choice of screen and letter colors and provides two areas for stationary messages to appear. The mid-screen area is used for the moving display, while the upper- and lower-screen portions may be used for up to five lines of stationary messages or graphics. The format is as follows:

1. Choose screen and border colors
2. Top screen message (yes or no)
   - **a.** letter color
   - **b.** five lines of messages
3. Bottom screen message (yes or no)
   - **a.** letter color
   - **b.** five lines of messages
4. Moving display letter color
   - **a.** reverse or normal letters
   - **b.** number of characters needed
5. Write display message
6. Run

The length of any message is determined and limited only by the amount of memory available. You select the approximate number of characters needed and perform a DIM statement on A$. It will hold the characters entered for your display message.

RETURN Key Options

The RETURN is used to speed input. Using RETURN for any input requested in the program will give preset values; for colors RETURN selects blue; for screen and border, RETURN gives cyan with white screen; and for yes or no questions, RETURN gives a no answer. Once the message is running it is in an endless loop. To stop the program, hit the RUN/STOP key and the RESTORE key at the same time.

The program as shown does not have the capability to save and store a message on tape for later use. That takes more memory and, therefore, limits the length of messages you can write. If you have an expanded VIC-20, however, you need not worry about memory space. Additions and changes for the Display Messages program are included to change it into a display and save program (see Program 3). Program 3 can be used on an unexpanded VIC-20 if you are careful to use 25 or fewer characters in your moving display message. If you use more than 25 characters, there is not enough memory to complete the save portion of the program. You will get an "out of memory" error and will have lost your message.

Ideas For Other Programs

Several programming ideas here might prove useful in other programs. One is the use of the letter color subroutine. If you look at lines 400 to 510, you will notice that the routine uses DATA statements to select the correct CHR$ number. The number of the color input in line 420 tells line 440 how many of the DATA statements to read in line 510. The CHR$ number read from the DATA statement then sets the color for CHR$(X(G)) which is used in the program to PRINT the color selected.

By adding and changing the lines from Program 3, you will have a program which can save a display on a file tape. This file tape can be used later with Program 4 to play back your message.

You can also have upper- and lowercase letters in your display messages by pressing the SHIFT and COMMODORE keys at the same time. Do this at the beginning of the program. You can save the program on a file tape, recover it using the load display, then press the SHIFT and COMMODORE keys to restore proper case.

Program 4 recovers the data from a file tape containing the message. Lines 30-130 use this data to display the message. You may notice that in line 224 the value of I has been doubled. This is necessary because as the data is saved on the file tape with a GET# statement, a CHR$(13), a RETURN, is entered after each data bit. Without doubling (I) you are returned only half of your message, and it contains a space between each character. Line 80 then takes the doubled (I) and by using a STEP 2 eliminates all of the spaces caused by the GET# statement. The result is a display message exactly like the one saved by the display and save program.

If you put Program 4 as the first program on a file tape, then save your messages after it, you'll have easy access to your library of messages. Just one tape is needed since the load and file are together.

If you would like the programs, but don't have time to type them in, send $3, a tape, and a stamped, self-addressed mailer to:

Rick Keim
306 Yorktown Dr.
Goshen, IN 46526

Program 1:
Routine For Short Reusable Display Messages

```
10 PRINT"{CLR}"
20 READ A$
30 IF A$="-1" THEN RESTORE:GOTO 20
40 PRINT"{HOME}{11 DOWN}"
50 PRINT TAB(20)"";A$:PRINT"{21 LEFT}";CH
   R$(20)
60 FOR T=1 TO 150:NEXT:GOTO 20
100 DATA T,H,I,S, ,I
110 DATA S, ,A, ,D,I
120 DATA S,P,L,A,Y
130 DATA ,M,E,S,S,A
140 DATA G,E, , , , ,-1
```

Program 2:
Program For Long Display Messages

```
0 PRINT"{CLR}{3 SPACES}{3 DOWN}{RVS}
  {RED}DISPLAY MESSAGES{OFF}{BLU}"
4 PRINT"{4 DOWN}(SEE VIC SCREEN CODES
  {2 SPACES}APPENDIX E PAGE 134
  {4 SPACES}VIC-20 GUIDE BOOK)"
5 INPUT"{6 UP}SCREEN COLOR#(8-255)";C
6 IFC<8ORC>255THENC=27
8 GOSUB200:RESTORE
10 PRINT"{CLR}{DOWN}{RVS}{RED}DISPLAY ME
   SSAGE{OFF}{BLU}{7 SPACES}(MOVING)
   {DOWN}"
12 GOSUB400
14 PRINT"{2 DOWN}{2 SPACES}{RVS}{RED}REV
   ERSE{OFF}{BLU} OR NORMAL?{3 SPACES}1-
   {RVS}{RED}REVERSE{OFF}{BLU}{3 SPACES}
   0-NORMAL":INPUTR
15 IFR=1THENR=18
16 PRINT"{CLR}{DOWN}{2 SPACES}# OF LETTE
   RS NEEDED{3 SPACES}FOR MOVING MESSAGE
   {3 SPACES}(PUSH RETURN FOR 250)"
17 INPUTML:IFML=0THENML=250
18 DIMA$(ML)
20 PRINT"{CLR}{DOWN}{5 SPACES}{RVS}{BLU}
   WRITE MESSAGE{OFF}":PRINT"{13 DOWN}
   {2 SPACES}{RVS}{RED}PUSH RETURN TO EN
   D{OFF}{BLU}"
22 PRINT"{DOWN}{3 SPACES}PUSH F1 TO STAR
   T{7 SPACES}MESSAGE OVER"
23 PRINT"{DOWN}{2 SPACES}USE {RVS}{RED}I
   NST/DEL{OFF}{BLU} TO{6 SPACES}BACKSPA
   CE ON ERRORS"
25 FORI=0TOML
30 GETA$:IFA$=""THEN30
35 IFA$=CHR$(13)THENFORI=ITOI+5:A$(I)=CH
   R$(32):NEXTI:PRINT"{CLR}":GOTO100
36 IFA$=CHR$(133)THEN20
37 IFA$=CHR$(20)THENI=I-1:GOTO52
45 PRINT"{HOME}{2 DOWN}":PRINTTAB(I)"";A
   $:A$(I)=A$
50 NEXTI:GOTO60
52 PRINT"{HOME}{2 DOWN}":PRINTTAB(I)"
   {LEFT}":GOTO30
```

```
60 PRINT"{CLR} SORRY-OUT OF MESSAGE
   {2 SPACES}SPACE, INCREASE # OF
   {2 SPACES}LETTERS NEEDED"
62 PRINT"{DOWN}{5 SPACES}PUSH {RVS}RETUR
   N{OFF}{BLU}":PRINT"{4 SPACES}TO START
   OVER"
64 GETA$:IFA$=""THEN64
66 POKE36879,27:RUN
100 PRINT"{CLR}":POKE36879,C
101 PRINT"{HOME}{2 DOWN}"
102 FORD=ØTOT:PRINTTAB(L(D))""CHR$(X(1))
   ;TS$(D):NEXTD
103 PRINT"{HOME}{14 DOWN}"
104 FORD=ØTOU:PRINTTAB(LL(D))""CHR$(X(2)
   );BS$(D):NEXTD
105 PRINT"{HOME}{1Ø DOWN}"
110 FORN=ØTOI
120 PRINTTAB(2Ø)"";CHR$(R);CHR$(X(3));A$
   (N);"{2Ø LEFT}";CHR$(2Ø)
130 PRINT"{2 UP}"
135 FORT=1TO15Ø:NEXT
140 IFN=ITHEN1Ø5
150 NEXTN
200 PRINT"{CLR}{DOWN}ANY NON-MOVING MESS
   AGE FOR TOP SCREEN":PRINTTAB(5)"1-
   {RVS}{RED}YES{OFF}{BLU}","Ø-NO":INPU
   TS
202 ONSGOSUB21Ø:GOTO25Ø
210 RESTORE:GOSUB4ØØ
211 PRINT"{CLR}{DOWN}WRITE UP TO 5 LINES
    AT22 CHARACTERS PER LINE"
212 PRINT"PUSH {RVS}{RED}RETURN{OFF}
   {BLU} TO END"
214 FORT=ØTO4:INPUTTS$(T):IFTS$(T)=""THE
   NRETURN
216 L(T)=(22-LEN(TS$(T)))/2
218 PRINTTAB(L(T))"";TS$(T):NEXTT:RETURN
250 PRINT"{CLR}{DOWN}ANY NON-MOVING MESS
   AGE FOR BOTTOM SCREEN":PRINTTAB(5)"1
   -{RVS}{RED}YES{OFF}{BLU}","Ø-NO"
252 INPUTD
254 ONDGOSUB26Ø:RETURN
260 RESTORE:GOSUB4ØØ
261 PRINT"{CLR}{DOWN}WRITE UP TO 5 LINES
    AT22 CHARACTERS PER LINE"
262 PRINT"PUSH {RVS}{RED}RETURN{OFF}
   {BLU} TO END"
264 FORU=ØTO4:INPUTBS$(U):IFBS$(U)=""THE
   NRETURN
266 LL(U)=(22-LEN(BS$(U)))/2
268 PRINTTAB(LL(U))"";BS$(U):NEXTU:RETUR
   N
400 PRINT"LETTER COLOR? (CHOOSE COLOR #)
   ":G=G+1
410 FORA=ØTO7:READA$:PRINTTAB(5)"";A$:NE
   XTA
420 INPUTLC(G)
430 IFLC(G)<1ORLC(G)>8THENX(G)=31:GOTO14
440 FORB=1TOLC(G):READW:NEXTB:X(G)=W
450 RETURN
500 DATA1-BLACK,2-WHITE,3-RED,4-CYAN,5-P
   URPLE,6-GREEN,7-BLUE,8-YELLOW
510 DATA144,5,28,159,156,3Ø,31,158
```

Program 3: Save And Display Messages

```
16 PRINT"{CLR}{DOWN}{2 SPACES}# OF LETTE
   RS NEEDED{3 SPACES}FOR MOVING MESSAGE
   {3 SPACES}(PUSH RETURN FOR 1ØØ)
17 INPUTML:IFML=ØTHENML=1ØØ
35 IFA$=CHR$(13)THENFORI=ITOI+5:A$(I)=CH
   R$(32):NEXTI:PRINT"{CLR}":GOTO7ØØ
90 PRINT"{CLR}{4 DOWN}{4 SPACES}PUSH ANY
    KEY TO{2 SPACES}{DOWN}{2 SPACES}STOP
    DISPLAY MESSAGE {DOWN}{4 SPACES}AND
   RETURN TO"
92 PRINT"{DOWN}{4 SPACES}{RVS}{RED}SELEC
   T OPTION{OFF}{BLU}"
95 FORQ=ØTO2ØØØ:NEXT
135 FORTT=ØTO25:GETC$:IFC$=""THEN138
136 POKE36879,27:PRINT"{CLR}":GOTO7ØØ
138 NEXTTT
600 POKE36879,27:PRINT"{CLR}{2 DOWN}
   {RVS}{RED}SAVE FILE#{OFF}{BLU}":INPU
   TF
610 OPENF,1,1
620 B(Ø)=I:B(1)=T:B(2)=U:B(3)=C:B(4)=R
622 FORA=ØTO4:PRINT#F,B(A):NEXT
625 FORG1=1TO3:PRINT#F,X(G1):NEXT
630 FORT1=ØTOT:PRINT#F,TS$(T1):NEXT
640 FORT2=ØTOU:PRINT#F,BS$(T2):NEXT
650 FORII=ØTOI:PRINT#F,A$(II):NEXT
660 CLOSEF
700 PRINT"{2 DOWN}{RVS}{RED}SELECT OPTIO
   N{OFF}{BLU}{DOWN}":PRINT"{4 SPACES}
   {RVS}1{OFF}-NEW MESSAGE":PRINT"
   {4 SPACES}{RVS}2{OFF}-SAVE MESSAGE"
710 PRINT"{4 SPACES}{RVS}3{OFF}-RUN MESS
   AGE"
720 INPUT"{RVS}SELECTION{OFF}";SO
730 IFSO<2THEN66
740 IFSO=2THEN6ØØ
750 IFSO>2THEN9Ø
```

Program 4: Message Playback

```
10 PRINT"{CLR}":
20 GOSUB2ØØ
30 PRINT"{CLR}":POKE36879,C
40 FORD=ØTOT:L(D)=(22-LEN(TS$(D)))/2:PRI
   NTTAB(L(D))""CHR$(X(1));TS$(D):NEXT
50 PRINT"{HOME}{15 DOWN}"
60 FORD=ØTOU:LL(D)=(22-LEN(BS$(D)))/2:PR
   INTTAB(LL(D))"";CHR$(X(2));BS$(D):NEX
   T
70 PRINT"{HOME}{1Ø DOWN}"
80 FORN=ØTOISTEP2
90 PRINTTAB(2Ø)"";CHR$(R);CHR$(X(3));A$(
   N);"{2Ø LEFT}";CHR$(2Ø)
100 PRINT"{2 UP}"
110 FORT=1TO15Ø:NEXTT
120 IFN=ITHEN7Ø
130 NEXTN
200 PRINT"{CLR}{2 DOWN}{RVS}{RED}LOAD FI
   LE#{OFF}{BLU}":INPUTF:INPUT"FILE NAM
   E";F$
210 OPENF,1,Ø,F$
222 FORA=ØTO4:INPUT#F,B(A):NEXT
224 I=B(Ø)*2:T=B(1):U=B(2):C=B(3):R=B(4)
230 DIMA$(I)
240 FORG1=1TO3:INPUT#F,X(G1):NEXT
250 FORT1=1TOT:INPUT#F,TS$(T1):NEXT
260 FORT2=1TOU:INPUT#F,BS$(T2):NEXT
270 FORII=1TOI:GET#F,A$(II):NEXT
280 RETURN
```

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Floating Point Division

Matt Ganis

The screen given below will create four new words (three "helper" words and one main word). Here is a description of all four words:

1TO3 – This word will duplicate the value on top of the stack into the third position of the stack (note: the current third value becomes the fourth value; the current fourth value becomes the fifth value, etc.).

For example, if the stack looks like this:

[1 2 3]
top bottom

A call to 1TO3 will leave the stack as follows:

[1 2 1 3]
top bottom

QUOT – This word will compute and output the quotient of A/B. Also, the decimal point is output in this word (the 46 EMIT. is a decimal value of 46).

REMAIN – This word will output the next digit in the remainder. It should be understood that on each call only *one* digit is returned. Also, the 48 + converts the digit to ASCII code so that it can be printed instead of being popped off the stack with the . word.

FPDIV – This is the word that will be used when you want to divide two numbers (for example, 5 3 FPDIV will divide 5/3). In this example, FPDIV will return ten digits of the remainder (because of the 10/0 DO LOOP). If, for some reason, you want 100 digits in the remainder, simply change the 10 to a 100.

The value returned can't be used in a program. It is useful in that you may divide two numbers and obtain any precision that you desire.

Screen for the floating point division word.
For fig-FORTH or compatible FORTHs

```
SCR # 76

: 1TO3 DUP ROT SWAP ;

: QUOT 1TO3 /MOD . 10 * SWAP
  1TO3 46 EMIT ;

: REMAIN /MOD 48 + EMIT
  10 * SWAP 1TO3 ;

( **MAIN WORD IS 'FPDIV' *** )

: FPDIV DECIMAL QUOT 10 0 DO
  REMAIN LOOP DROP DROP DROP ;

;S
```

Make these changes if your /MOD works 'backwards':

```
: QUOT 1TO3 /MOD SWAP . 10 * SWAP
: REMAIN /MOD SWAP 48 + EMIT
```

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NEWS&PRODUCTS

Atari Disassembler

Ultra Disassembler, a labelling disassembler for Atari computers, is available from Adventure International.

The program recreates the source code from which a machine language program was assembled. It can disassemble DOS files or code from a list of specified disk sectors.

Output may be written to the screen, printer, or disk file. The disassembly is reversible and may be edited and reassembled with any popular Atari assembler.

Ultra Disassembler sells for $49.95.

Adventure International
Box 3435
Longwood, FL 32750

Vocabulary Builder

Power-of-Words, a word learning game designed by Peter Funk, author of the "It Pays to Increase Your Word Power" column in *Reader's Digest*, is available for Apple computers.

Each volume includes 200 target words and their associated synonyms, antonyms, prefixes, and suffixes. The game features immediate scoring, and after an answer is scored, the program provides additional information about the words used in the quiz.

Power-of-Words, which sells for $79.95, includes two diskettes of five games each, worksheets, and a final quiz covering the words in all the games.

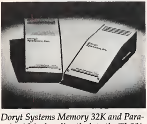
Funk Vocab-Ware
Peter Funk, Inc.
4825 Province Line Road
Princeton, NJ 08540

Memory Expansion And Printer Interface For TI-99/4A

Doryt Systems has introduced a 32K memory expansion unit and a parallel printer interface for the TI-99/4A, both of which can be used without the expansion box.

Paraprint 18A is a parallel 8-bit communication interface that connects directly to the computer and works without the RS-232 interface card. The interface sells for $105.

Memory 32K adds RAM to the TI-99/4A, allowing the use of the Editor Assembler, TI Logo,



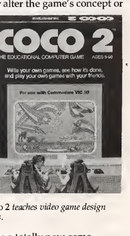
Doryt Systems Memory 32K and Paraprint 18A plug directly into the TI-99/4A and eliminate the need for an expansion box.

and other modules that require memory expansion. Like Paraprint 18A, it plugs directly into the computer and provides a daisy-chain connection for other TI peripherals. Memory 32K is priced at $175.

Doryt Systems, Inc.
14 Glen Street
Glen Cove, NY 11542
(516)676-7950

Game Design Tutor

Coco 2 is a teaching game that explores the fundamentals of computer game design with an approach that assumes no prior computer knowledge. The program follows a fully developed sample game and then helps the user alter the game's concept or



Coco 2 *teaches video game design skills.*

write a totally new game.

Coco 2 is available for the 16K VIC for $39.95. Versions also are available for the Commodore 64, the 32K Atari 400, and the Atari 800 for $44.95.

Human Engineered Software
71 Park Lane
Brisbane, CA 94005

The Computer Control Center is a molded polystyrene work station for the Timex/Sinclair computers.

Timex/Sinclair Control Center

A desk-type work station for the Timex/Sinclair 1000 and Sinclair ZX-81 computers is being marketed by Timeworks.

The Computer Control Center includes an on/off switch to eliminate the constant plugging and unplugging of the system. It also includes space for RAM packs, openings for cassette and printer cables, and a cassette tape storage pocket.

The top of the unit, which is priced at $29.95, can accommodate a 13-inch television or monitor.

Timeworks, Inc.
405 Lake Cook Road, Building A
Deerfield, IL 60016
(312) 291-9200

Game, Utilities For Atari

Generic Software has produced a software package called *Your First Disk* for Atari computers.

The disk includes *Wordzzp*, an educational spelling and vocabulary game, as well as *Catalog*, an autorun disk directory program, and *Sound.Exp*, a program for sound statement experimentation. The diskette also includes files for alphabet learning and math problem creation.

The *Your First Disk* package sells for $18.95.

Generic Software
P.O. Box 27463
Golden Valley, MN 55427

3-Inch Disk Drive

A compact, 3-inch floppy disk drive is available from Panasonic. The drive is plug compatible with most 5¼-inch disk interfaces and uses the same recording method, data transfer rate, and disk rotation speed.

The EME-101 drive is roughly half the weight and one-fourth the size of conventional disk drives, but it offers the same storage capacity. A brushless direct-drive DC motor eliminates the need for belts, and a steel band positioning mechanism allows for a 3-millisecond track access time.

Panasonic
One Panasonic Way
Secaucus, NJ 07094

The EME-101 compact disk drive from Panasonic.

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Julian, Calif. 92036

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Extended Screen Graphics For Apple

Fontrix, an extended screen graphics program for the Apple computer, includes 11 predefined character sets and allows the creation of an unlimited number of other character sets.

The program can be used for charts, diagrams, and newsletters, among other things, and text or illustrations created with the program can be dumped into a variety of printers.

The *Fontrix* program costs $75.

Data Transforms
616 Washington St., Suite 106
Denver, CO 80203

Action/Strategy Games

Several new games for the Atari and Commodore 64 computers are forthcoming from Epyx. They include:

- *PitStop* is a formula I race game in which the players compete in the pit as well as on the track. The race cars include speed and steering controls, and the way you drive affects your car's performance: the faster you take the corners, the faster your tires wear out.
- *Psi Warrior* is a three-dimensional, chess-like game. Up to four players compete against each other or the computer, teleporting around the playing field, and using bolts of energy in their battles.
- In *All-Star Baseball*, players choose an all-star team made up of players from over the last 50 years. Another player or the computer can field the opposing team.
- *Gateway to Apshai*, the latest sequal to *Temple of Apshai*, combines role playing, strategy, and fast action as the player battles his way in and out of the dungeons.

Epyx is also introducing a VIC-20 game, *Fun With Music*. In the game, the player composes a tune and then has to play the song (or one supplied by the computer) without missing a note.

Epyx, Inc.
1043 Kiel Court
Sunnyvale, CA 94086

Organized Programming On TRS-80

Top-Down BASIC for the TRS-80 Color Computer, by Ken Skier, is a book on program design for the computer user who is familiar with BASIC.

The 316-page book outlines a step-by-step approach to produce structured programs that

are easy to read, understand, and extend. The paperback book sells for $14.95.

BYTE Books/McGraw-Hill
1221 Avenue of the Americas
New York, NY 10020

Expansion For VIC

Mosaic Electronics has introduced the RAMmaster 32 for the VIC-20 computer. RAMmaster 32 includes a built-in expansion port, a pause switch, a write protect switch, and a relocatable memory block.

The unit, which adds 32K of memory, also has a disabler switch so cartridges can be removed without turning off the computer. RAMmaster 32 is expected to sell for under $150.

Mosaic Electronics
P.O. Box 708
Oregon City, OR 97045
(800)547-2807

Atari Graphics Utilities

A graphics utility package for the Atari 400 and 800 computers has been released by Synergistic Software.

The *Graphics Workshop*, designed for those familiar with Atari BASIC, includes a player/missile module, a graphics enhancement module, and three graphics editors – a player/missile editor, a bitmap editor, and a character editor.

The program, which is priced at $39.95, requires a 48K computer with one disk drive.

Synergistic Software
830 N. Riverside Dr., Suite 201
Renton, WA 98055
(800) 426-6505

Wico's Command Control Mouse is an optically encoded mechanical cursor control.

Command Control Mouse

Wico has announced it will produce the Command Control Mouse, a mechanical cursor control that allows users to edit, draw lines, or select from a menu without ever touching the keyboard.

By sliding the hand-held device across a desktop, the user can move the cursor to any point on the screen.

The mouse can serve as a word processing editor, a spreadsheet analyst, an alternate input device, or as a graphics plotter. It includes three function buttons and can be used on any flat surface.

Wico will supply Apple or IBM controller cards to serve as hardware interfaces.

Wico Corporation
6400 W. Gross Point Road
Niles, IL 60648

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Commodore "64"	$369.96

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8050 Dual Drive 1 mg	$1256.50
1541 170k for Commodore 64	$317.95
1530 DATASETTE VIC 20 & COMMODORE 64	$63.00

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8300P daisy wheel	$1436.40
8023 dot matrix printer	$572.40
1525 VIC or COM. 64	$317.95

CABLES

IEEE-IEEE	$42.95
PET-IEEE	$34.95

COMMODORE COLOR MONITORS

Model 1701	$239.95

★★★★★★★★★★★★★★

COMMADORE 64 VIC-20

8 Expansion Connectors
Each Switched Individually
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Master Power Switch with 2 110v AC OUTLETS for computer and accessories
RIBBON CABLE Connection for convenient placement
LED DISPLAY
RESET Button
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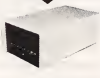

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Timex/Sinclair Guidebooks

The Timex/Sinclair 1000 BASIC Handbook, from Sybex, is a dictionary-like listing of all the words in the T/S 1000 BASIC vocabulary.

Each entry includes a description of the word, an example of its proper syntax, a sample program showing how the word is used, and notes explaining any special features of the word.

The book is available for $7.95, plus $2 for postage.

Sybex, Inc.
2344 Sixth St.
Berkeley, CA 94701

In *How to Use the Timex/Sinclair*, Jerry Willis explains the problems many Timex/Sinclair users face: how to get a clear TV picture, how to minimize tape recorder problems, and how to choose accessories for the computer.

The guide, priced at $3.95, also includes information on magazines, books, and user groups that support the Timex/Sinclair computers.

dilithium Press
11000 S. W. 11th St., Suite E
Beaverton, OR 97005

ABC's On Atari

Alphabet Arcade, a series of three games to help reinforce alphabet and dictionary skills, is available from PDI.

The Atari games are designed for children age 5 and up. In "Letters for Lisa," the child helps an animal named Lisa catch letters for dinner. But Lisa is fussy; she only eats in alphabetical order.

In "Letter Treasure," alphabetization skills come into play again as the player helps Diver Dan recover treasure from the bottom of the sea. In "Order, Please," the child is asked to put groups of 4, 8, or 10 words in alphabetical order.

The cassette version of *Alphabet Arcade* requires a 16K machine and sells for $18.95. The disk version, which requires 24K, sells for $23.95.

Program Design Inc.
95 East Putnam Ave.
Greenwich, CT 06830
(203) 661-8799

Low Profile Drives For Apple

Multitech Electronics has introduced a 5¼-inch disk drive for the Apple II that is approximately half the height and weight of a comparable drive from Apple. The design was made possible by simplifying the drive mechanism and by integrating the control electronics. The pro-

commodore

VIC-20
$99

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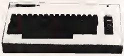
$427



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List price for the drive is $299.

Multitech Electronics, Inc.
195 W. El Camino Real
Sunnyvale, CA 94086

Loss-of-Data Insurance

The Association of Computer Users and the St. Paul Fire and Marine Insurance Companies have announced a new type of insurance for small computer owners that includes coverage for accidental loss of data.

The policy covers:

- Direct physical loss or damage to equipment, disks, programs, documentation, and source materials.
- Accidental erasure or loss of data.
- Dishonest acts, fraud, or misuse of equipment by employees or outside parties.
- Extraordinary damage to equipment caused by external electrical problems, such as spikes, brownouts, or power surges.
- Extra expenses incurred as a result of a covered loss.

The cost of coverage is $175 per year for protection up to $25,000, with a $250 deductible.

Association of Computer Users
P.O. Box 9003
Boulder, CO 80301
(303)443-3600

Computer Diet For T/S

The *Personal Weight Control Program* is a computerized diet and nutrition program produced by International Publishing & Software for the Timex/Sinclair computers.

The program, which presents dieting as an exercise in controlling eating habits, consists of three parts:

- Present Status Assessment, which analyzes the eating habits and nutritional needs of the user.
- Menu Building, in which the computer develops menus suited to the needs and tastes of the user.
- Monitoring and Feedback, which tracks progress and adjusts menus accordingly.

The program is available for $29.95.

International Publishing &
Software, Inc.
3952 Chesswood Drive
Downsview, Ontario
Canada M3J 2W6

Music For Children

Counterpoint Software has released *Early Games Music*, another program in its Early Games for Young Children series. This program, designed for children ages 4 through 12, is an assortment of games that introduce the basics of music.

Songs created with the program can be saved and played or revised later. *Early Games Music* is available for Apple II and Commodore 64 computers.

Counterpoint Software Inc.
Suite 140, Shelard Plaza North
Minneapolis, MN 55426

Computer Resources

More than 215 new books are listed in the 16th edition of the *Annual Bibliography of Computer-Oriented Books*, published by the University of Colorado.

All introductory-type books published before 1980 have been deleted, but the bibliography still contains more than 1200 books from 170 publishers. The books are listed under 61 categories.

Copies of the bibliography are available for $5, or $6 if an invoice is required.

Computing Newsletter
P.O. Box 7345
Colorado Springs, CO 80933

The Micro Center has compiled a new *Time Saver* catalog of microcomputer courseware. The catalog lists 319 high-quality, high-value educational programs for the Apple, Atari, TRS-80, PET, VIC, and IBM PC.

Copies of the catalog are available free.

The Micro Center
P.O. Box 6
Pleasantville, NY 10570
(800)431-2434

Computer Skill Builders has produced a free catalog of microcomputer resources for the classroom. The book contains 304 computer-related products for education, including software products, books, diskettes, and supplies.

Computer Skill Builders
P.O. Box 42050, Dept. 7Z
Tucson, AZ 85733
(602)323-7500

Selected Microcomputer Software, a 64-page catalog of educational courseware for the Apple II, TRS-80, Commodore PET, and Atari microcomputers, is available free from Opportunities for Learning.

Programs listed in the catalog cover grade levels from primary through college and were selected based on their suitability for use in today's computer-enhanced classroom environment.

Opportunities for Learning, Inc.
8950 Lurline Ave., Dept. L45
Chatsworth, CA 91311

Games For The TI

Vaughn Software has created an array of cassette programs for the TI-99/4A computer. They include:

- *Mariner*, a sea adventure

HARMONY VIDEO & COMPUTERS
800-221-8927

JVC ● PANASONIC ● SONY PROFEEL ● ZENITH ● HITACHI ● QUASAR

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ATARI	1200 XL W64K	589.95
ATARI	410 RECORDER	76.95
ATARI	1010 RECORDER	77.95
ATARI	810 DISC DRIVE	389.95
ATARI	830 ACOUSTIC TEL. MODEM	159.95
ATARI	850 INTERFACE	169.95
ATARI	822 THERMOL PRINTER	CALL
ATARI	1020 40 COL. PRINTER	219.95
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• *Red Dread*, an arcade-type board game in which you seek green gems while avoiding the Red Dread; $9.99.

• *Digger Duck*, a colorful maze game that requires strategic planning; $9.99.

• *Chromium Shuttle*, a space game in an endless starfield in which you control an onboard computer, warp drive, and asteroid analyzer; $13.99.

• *Chopper Fireman*, a game that pits you – in an aging and temperamental helicopter – against raging forest fires; requires Extended BASIC, $21.95.

• *Model Rocketry Performance*, an application program that provides the expected performance of model rockets, and allows for quick comparison of models on the drawing board; $25.99.

Vaughn Software
5460 Harlan #84
Arvada, CO 80002

Educational Programs For Apple And Atari

Random House has added several new reading, language arts, and mathematics programs to its library. All of the following programs require 48K computers with disk drives.

• *Fundamental Word Focus:* This series of ten programs for the Atari provides a game-like format to teach vowel identification, syllabication, compound words, and identification of word elements. It includes a record-keeping system and uses color graphics and sound.

• *Tutorial Comprehension:* This Apple program is designed to teach comprehension skills to second, third, and fourth graders. The five comprehension skills presented are details, sequence, main idea, inference, and critical reading.

• *Word Blaster:* This program for both Atari and Apple computers allows students to practice comprehension skills using context clues.

• *Fundamental Punctuation Practice:* This Apple program provides more than 30 lessons on basic punctuation skills. An off-line diagnostic placement test is included with the program.

• *Story Builder:* This Atari program, based on the concept of mix-and-match storybooks, allows students to experiment with sentence structure and to create new and often humorous story situations.

• *Galaxy Math Facts Game* and *Grand Prix:* These games, available in both Apple and Atari versions, put the student at the helm of a spaceship or at the controls of a Grand Prix racer. In each case, the student must show a mastery of basic math facts before he or she can complete the mission, or speed past the checkered flag.

Random House, Inc.
7307 South Yale Avenue
Suite 103
Tulsa, OK 74136

T/S Game In 3-D

Softsync has released *Mothership*, an arcade-style game for the Timex/Sinclair computers.

The game features one or two player options, three levels of play, on-screen scoring and a display that looks as if it's in 3-D.

In *Mothership*, which sells for $16.95 plus $1.50 for shipping and handling, players maneuver their Starlight Fighters down the Zarway space corridor toward the imposing Mothership, which is launching an all-out attack on the planet. Players use the keyboard as a control panel to move their ships through the corridor, while dodging the drone fighters launched by the Mothership.

Softsync, Inc.
14 East 34th Street
New York, NY 10016

CALENDAR

August 10-12, Madison, WI. The second annual Microcomputers and High Technology Conference in Vocational Education. The conference includes beginning and advanced classes on programming, PILOT, CAD, courseware design, and administration. Discussions are planned on microcomputer development and application, and on existing vocational/educational programs using computers. For information, write Dr. Judith Rodenstein, 964 Educational Science Building, 1025 W. Johnson Street, Madison, WI 53706.

August 28, Harrisburg, PA. The Central Pennsylvania Repeater Association will sponsor its 10th Annual Hamfest/Computer Fest. The event, which will be held adjacent to Hersheypark, Chocolate Town, U.S.A., includes indoor dealer displays and a flea market area. Registration $3; tables and table space available. For more information, write Timothy R. Fanus, 6140 Chambers Hill Road, Harrisburg, PA 17111.

New Product releases are selected from submissions for reasons of timeliness, available space, and general interest to our readers. We regret that we are unable to select all new product submissions for publication. Readers should be aware that we present here some edited version of material submitted by vendors and are unable to vouch for its accuracy at time of publication.

COMPUTE! *welcomes notices of upcoming events and requests that the sponsors send a short description, their name and phone number, and an address to which interested readers may write for further information. Please send notices at least three months before the date of the event, to: Calendar, P.O. Box 5406, Greensboro, NC 27403.*

CAPUTE!

Modifications Or Corrections To Previous Articles

TI Teeth Wisdom

Line 650 of this program from the July 1983 "Programming The TI" column (p. 199) should read:

```
650 PRINT " ";CHR$(156);"¦}e";CHR$(
    136)&CHR$(137)&CHR$(138);"e~";CH
    R$(127)&CHR$(157)
```

Bee Trap For VIC

In the instructions for keyboard play on page 102 of the June 1983 issue, line 320 should read:

```
320 IFPEEK(KB)=35THEND1=D1+22:GOTO335
```

Memory Trainer For TI

For the TI-99/4A version of this program (June 1983, p. 118) to work in standard TI console BASIC, the following changes must be made:

```
240 IF (DR<1)+(DR>10) THEN 140
270 IF SL<2 THEN 275 ELSE 280
275 SL=2
280 IF SL>90 THEN 285 ELSE 290
285 SL=90
```

Thanks to David Duffan and others who suggested this change.

Atari P/M Graphics Simplified

The following lines in the moving ship example program developed on pages 175-178 of the June 1983 issue need corrections:

```
310 POKE VSA+ADD+1,PMHIGH
360 COLR1=25:COLR2=11:COLR3=74
370 POKE 704,COLR1:POKE 705,COLR2:POKE
    706,COLR3
400 Y1=125:Y2=25:Y3=25
```

Slow List On The VIC-20

The mysterious memory location 37879 described in this article from the June issue (p. 180) is actually location 37159, the high byte of the interrupt clock. Because of incomplete address decoding for the I/O chips, the contents of locations 37136-37167 appear to repeat several times in locations 37168-37887. The location normally contains 66, not 64 as stated in the article. For a thorough discussion of the effects of changing the contents of location 37159, see the article "Versatile Data Acquisition With VIC" (**COMPUTE!**, May 1983, p. 244).

UnNEW For VIC And 64

This utility program from the June 1983 issue (p. 213) will *not* work from disk. It must be SAVEd to tape in the manner described in the article.

Minefield For 64

The 64 version of this game from the June issue (p. 266) requires the following correction:

```
360 B3(J)=BT(J)+.5*BT(J):B4(J)=B3(J)+.25
    *BT(J)
```

Checkers

To allow legal jumps with kings in this game for the Commodore 64 (May 1983, p. 90), the following line must be changed:

```
585 IFL1<=5ANDU1>=2THENIFS(LP,UM)<0ANDS(L1
    +2,U1-2)=0THEN600
```

Crosswords For VIC

Line 860 of this program from the May issue (p. 82) should read:

```
860 GET F$:IF F$ = " " THEN 860
```

TI General-Purpose Data Base

Line 203 of this data base management program for the TI from the May issue (p. 232) should read:

```
203 FOR IO = 1 TO IR
```

64 Odds And Ends

The article (May 1983, p. 237) noted that listing could be disabled by POKE 775,200. To restore the list feature, POKE 775,167.

Retirement Planner For VIC

Robert A. Brown suggests modifications which make this program for calculating retirement saving needs from the April 1983 issue (p. 71) more accurate, and also allow calculations for any time period, not just multiples of five years. First, delete lines 120, 460-500, 590, and 600, then make the following changes:

```
510 D=AI/(1+AI/2):Q=((1+AI)↑Y-1)/D
540 W=(SR-S1*(1+AI)↑Y)/Q
```

We regret that we are no longer able to respond to individual inquiries about programs, products, or services appearing in **COMPUTE!** *due to increasing publication activity. On those infrequent occasions when a published program contains a typo, the correction will appear on the CAPUTE! page, usually within eight weeks. If you have specific questions about items or programs which you've seen in* **COMPUTE!**, *please send them to Readers Feedback, P.O. Box 5406, Greensboro, NC 27403.* ©

A Beginner's Guide To Typing In Programs

What Is A Program?

A computer cannot perform any task by itself. Like a car without gas, a computer has *potential*, but without a program, it isn't going anywhere. Most of the programs published in **COMPUTE!** are written in a computer language called BASIC. BASIC is easy to learn and is built into most computers (on some computers, you have to purchase an optional BASIC cartridge).

BASIC Programs

Each month, **COMPUTE!** publishes programs for many machines. To start out, type in only programs written for your machine, e.g., "TI Version" if you have a TI-99/4. Later, when you gain experience with your computer's BASIC, you can try typing in and converting certain programs from one computer to yours.

Computers can be picky. Unlike the English language, which is full of ambiguities, BASIC usually has only one "right way" of stating something. Every letter, character, or number is significant. A common mistake is substituting a letter such as "O" for the numeral "0", a lowercase "l" for the numeral "1", or an uppercase "B" for the numeral "8". Also, you must enter all punctuation such as colons and commas just as they appear in the magazine. Spacing can be important. To be safe, type in the listings *exactly* as they appear.

Brackets And Special Characters

The exception to this typing rule is when you see the curved bracket, such as "{DOWN}". Anything within a set of brackets is a special character or characters that cannot easily be listed on a printer. When you come across such a special statement, refer to the appropriate key for your computer. For example, if you have an Atari, refer to the "Atari" section in "How to Type COMPUTE!'s Programs "

About DATA Statements

Some programs contain a section or sections of DATA statements. These lines provide information needed by the program. Some DATA statements contain actual programs (called machine language); others contain graphics codes. These lines are especially sensitive to errors.

If a single number in any one DATA statement is mistyped, your machine could "lock up," or "crash." The keyboard, break key, and RESET (or STOP) keys may all seem "dead," and the screen may go blank. Don't panic – no damage is done. To regain control, you have to turn off your computer, then turn it back on. This will erase whatever program was in memory, so always SAVE a copy of your program before you RUN it. If your computer crashes, you can LOAD the program and look for your mistake.

Sometimes a mistyped DATA statement will cause an error message when the program is RUN. The error message may refer to the program line that READs the data. *The error is still in the DATA statements, though.*

Get To Know Your Machine

You should familiarize yourself with your computer before attempting to type in a program. Learn the statements you use to store and retrieve programs from tape or disk. You'll want to save a copy of your program, so that you won't have to type it in every time you want to use it. Learn to use your machine's editing functions. How do you change a line if you made a mistake? You can always retype the line, but you at least need to know how to backspace. Do you know how to enter inverse video, lowercase, and control characters? It's all explained in your computer's manuals.

A Quick Review

1) Type in the program a line at a time, in order. Press RETURN or ENTER at the end of each line. Use backspace or the back arrow to correct mistakes.

2) Check the line you've typed against the line in the magazine. You can check the entire program again if you get an error when you RUN the program.

3) Make sure you've entered statements in brackets as the appropriate control key (see "How To Type COMPUTE!'s Programs" elsewhere in the magazine.)

We regret that we are no longer able to respond to individual inquiries about programs, products, or services appearing in **COMPUTE!** *due to increasing publication activity. On those infrequent occasions when a published program contains a typo, the correction will appear on the CAPUTE! page, usually within eight weeks. If you have specific questions about items or programs which you've seen in* **COMPUTE!**, *please send them to Readers Feedback, P.O. Box 5406, Greensboro, NC 27403.* ©

How To Type COMPUTE!'s Programs

Many of the programs which are listed in **COMPUTE!** contain special control characters (cursor control, color keys, inverse video, etc.). To make it easy to tell exactly what to type when entering one of these programs into your computer, we have established the following listing conventions. There is a separate key for each computer. Refer to the appropriate tables when you come across an unusual symbol in a program listing. If you are unsure how to actually enter a control character, consult your computer's manuals.

Atari 400/800

Characters in inverse video will appear like: INVERSE VIDEO
Enter these characters with the Atari logo key, { }

When you see	Type	See	
{CLEAR}	ESC SHIFT <		Clear Screen
{UP}	ESC CTRL -	↑	Cursor Up
{DOWN}	ESC CTRL =	↓	Cursor Down
{LEFT}	ESC CTRL +	←	Cursor Left
{RIGHT}	ESC CTRL *	→	Cursor Right
{BACK S}	ESC DELETE	◀	Backspace
{DELETE}	ESC CTRL DELETE		Delete character
{INSERT}	ESC CTRL INSERT		Insert character
{DEL LINE}	ESC SHIFT DELETE		Delete line
{INS LINE}	ESC SHIFT INSERT		Insert line
{TAB}	ESC TAB	▶	TAB key
{CLR TAB}	ESC CTRL TAB		Clear tab
{SET TAB}	ESC SHIFT TAB		Set tab stop
{BELL}	ESC CTRL 2		Ring buzzer
{ESC}	ESC ESC		ESCape key

Graphics characters, such as CTRL-T, the ball character ● will appear as the "normal" letter enclosed in braces, e.g. {T}.

A series of identical control characters, such as 10 spaces, three cursor-lefts, or 20 CTRL-R's, will appear as {10 SPACES}, {3 LEFT}, {20 R}, etc. If the character in braces is in inverse video, that character or characters should be entered with the Atari logo key. For example, { ♥ } means to enter a reverse-field heart with CTRL-comma, {5 U} means to enter five inverse-video CTRL-U's.

Commodore PET/CBM/VIC/64

Generally, any PET/CBM/VIC/64 program listings will contain words within braces which spell out any special characters: {DOWN} would mean to press the cursor down key. {5 SPACES} would mean to press the space bar five times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing the other key), the key would be underlined in our listings. For example, S would mean to type the S key while holding the shift key. If you find an underlined key enclosed in braces (e.g., {10 N}), you should type the key as many times as indicated (in our example, you would enter ten shifted N's). Some graphics characters are inaccessible from the keyboard on CBM Business models (32N, 8032).

For the VIC and 64, if a key is enclosed in special brackets, ⌊ ⌋, you should hold down the *Commodore key* while pressing the key inside the special brackets. (The Commodore key is the key in the lower left corner of the keyboard.) Again, if the key is preceded by a number, you should press the key as many times as indicated.

The special character £ found in VIC and 64 listings represents the British pound symbol (£) key, found between the minus and CLR/HOME keys.

Rarely, you'll see in a Commodore 64 program a solitary letter of the alphabet enclosed in braces. These characters can be entered by holding down the CTRL key while typing the letter in the braces. For example, {A} would indicate that you should press CTRL-A.

About the *quote mode*: you know that you can move the cursor around the screen with the CRSR keys. Sometimes a programmer will want to move the cursor under program control. That's why you see all the {LEFT}'s, {HOME}'s, and {BLU}'s in our programs. The only way the computer can tell the difference between direct and programmed cursor control is the quote mode.

Once you press the quote (the double quote, SHIFT-2), you are in the quote mode. If you type something and then try to change it by moving the cursor left, you'll only get a bunch of reverse-video lines. These are the symbols for cursor left. The only editing key that isn't programmable is the DEL key; you can still use DEL to back up and edit the line. Once you type another quote, you are out of quote mode.

You also go into quote mode when you INSerT spaces into a line. In any case, the easiest way to get out of quote mode is to just press RETURN. You'll then be out of quote mode and you can cursor up to the mistyped line and fix it.

Use the following tables when entering special characters:

When You Read:	Press:	See:	When You Read:	Press:	See:	When You Read:	Press:	See:	When You Read:	Press:	See:
{BLK}			{BLU}			{5}			{F3}		
{WHT}			{YEL}			{6}			{F4}		
{RED}			{1}			{7}			{F5}		
{CYN}			{2}			{8}			{F6}		
{PUR}			{3}			{F1}			{F7}		
{GRN}			{4}			{F2}			{F8}		

All Commodore Machines

Clear Screen	{CLR}	Cursor Left	{LEFT}
Home Cursor	{HOME}	Insert Character	{INST}
Cursor Up	{UP}	Delete Character	{DEL}
Cursor Down	{DOWN}	Reverse Field On	{RVS}
Cursor Right	{RIGHT}	Reverse Field Off	{OFF}

8032/Fat 40 Conventions

Set Window Top	{SET TOP}	Erase To Beginning	{ERASE BEG}
Set Window Bottom	{SET BOT}	Erase To End	{ERASE END}
Scroll Up	{SCR UP}	Toggle Tab	{TGL TAB}
Scroll Down	{SCR DOWN}	Tab	{TAB}
Insert Line	{INST LINE}	Escape Key	{ESC}
Delete Line	{DEL LINE}		

Apple II / Apple II Plus

All programs are in Applesoft BASIC, unless otherwise stated. Control characters are printed as the "normal" character enclosed in brackets, such as {D} for CTRL-D. Hold down CTRL while pressing the control key. You will not see the special character on the screen.

TRS-80 Color Computer

No special characters are used, other than lowercase. When you see letters printed in inverse video (white on black), press SHIFT-0 to enter the characters, and then press SHIFT-0 again to return to normal uppercase typing.

Texas Instruments 99/4

The only special characters used are in PRINT statements to indicate where two or more spaces should be left between words. For example, ENERGY {10 SPACES} MANAGEMENT means that ten spaces should be left between the words ENERGY and MANAGEMENT. Do not type in the braces or the words 10 SPACES. Enter all programs with the ALPHA LOCK on (in the down position). Release the ALPHA LOCK to enter lowercase text.

Timex TS-1000, Sinclair ZX-81

Study your computer manual carefully to see how to enter programs. Do not type in the letters for each command, since your machine features single-keystroke entry of BASIC commands. You may want to switch to the FAST mode (where the screen blanks) while entering programs, since there will be less delay between lines. (If the blanking screen bothers you, switch to the SLOW mode.)

COMPUTE! Back Issues

Here are some of the applications, tutorials, and games from available back issues of **COMPUTE!**. Each issue contains much, much more than there's space here to list, but here are some highlights:

February 1981: Simulating PRINT USING, Using the Atari as a Terminal for Telecommunications, Attach a Printer to the Atari, Double Density Graphing on C1P, Commodore Disk Systems, PET Crash Prevention, A 25¢ Apple II Clock.

May 1981: Named GOSUB/GOTO in Applesoft, Generating Lower Case Text on Apple II, Copy Atari Screens to the Printer, Disk Directory Printer for Atari, Realtime Clock on Atari, PET BASIC Delete Utility, PET Calculated Bar Graphs, Running 40 Column Programs on a CBM 8032.

June 1981: Computer Using Educators (CUE) on Software Pricing, Apple II Hires Character Generator, Ever- expanding Apple Power, Color Burst for Atari, Mixing Atari Graphics Modes 0 and 8, Relocating PET BASIC Programs, An Assembler In BASIC for PET, QuadraPET: Multitasking?

July 1981: Home Heating and Cooling, Animating Integer BASIC Lores Graphics, The Apple Hires Shape Writer, Adding a Voice Track to Atari Programs, Machine Language Atari Joystick Driver, Four Screen Utilities for the PET, Saving Machine Language Programs on PET Tape Headers, Commodore ROM Systems, The Voracious Butterfly on OSI.

August 1981: Minimize Code and Maximize Speed, Apple Disk Motor Control, A Cassette Tape Monitor for the Apple, Easy Reading of the Atari Joystick, Blockade Game for the Atari, Atari Sound Utility, The CBM "Fat 40," Keyword for PET, CBM/PET Loading, Chaining, and Overlaying.

October 1981: Automatic DATA Statements for CBM and Atari, VIC News, Undeletable Lines on Apple, PET, VIC, Budgeting on the Apple, Switching Cleanly from Text to Graphics on Apple, Atari Cassette Boot-tapes, Atari Variable Name Utility, Atari Program Library, Train your PET to Run VIC Programs, Interface a BSR Remote Control System to PET, A General Purpose BCD to Binary Routine, Converting to Fat-40 PET.

December 1981: Saving Fuel $$ (multiple computers: versions for Apple, PET, and Atari), Unscramble Game (multiple computers), Maze Generator (multiple computers), Animating Applesoft Graphics, A Simple Printer Interface for the Apple II, A Simple Atari Wordprocessor, Adding High Speed Vertical Positioning to Atari P/M Graphics, OSI Supercursor, A Look At SuperPET, Supermon for PET/CBM, PET Mine Maze Game.

January 1982: Invest (multiple computers), Developing a Business Algorithm (multiple computers), Apple Addresses, Lowercase with Unmodified Apple, Cryptogram Game for Atari, Superfont: Design Special Character Sets on Atari, PET Repairs for the Amateur, Micromon for PET, Self-modifying Programs in PET BASIC, Tinymon: a VIC Monitor, Vic Color Tips, VIC Memory Map, ZAP: A VIC Game.

May 1982: VIC Meteor Maze Game, Atari Disk Drive Speed Check, Modifying Apple's Floating Point BASIC, Fast Sort For PET/CBM, Extra Atari Colors Through Artifacting, Life Insurance Estimator (multiple computers), PET Screen Input, Getting The Most Out Of VIC's 5000 Bytes.

August 1982: The New Wave Of Personal Computers, Household Budget Manager (multiple computers), Word Games (multiple computers), Color Computer Home Energy Monitor, Intelligent Apple Filing Cabinet, Guess That Animal (multiple computers), PET/CBM Inner BASIC, VIC Communications, Keyprint Compendium, Animation With Atari, VIC Curiosities, Atari Substring Search, PET and VIC Electric Eraser.

September 1982: Apple and Atari and the Sounds of TRON, Commodore Automatic Disk Boot, VIC Joysticks, Three Atari GTIA Articles, Color Computer Graphics, The Apple Pilot Language, Sprites and Sound on the Commodore 64, Peripheral Vision Exerciser (multiple computers), Banish INPUT Statements (multiple computers), Charades (multiple computers), PET Pointer Sort, VIC Pause, Mapping Machine Language, Editing Atari BASIC With the Assembler Cartridge, Process Any Apple Disk File.

January 1983: Sound Synthesis And The Personal Computer, Juggler And Thunderbird Games (multiple computers), Music And Sound Programs (multiple computers), Writing Transportable BASIC, Home Energy Calculator (multiple computers), All About Commodore WAIT, Supermon64, Perfect Commodore INPUTs, Atari Autonumber, Copy VIC Disk Files, Commodore 64 Architecture.

February 1983: How The Pros Write Computer Games, 12 Joysticks Compared, Slalom (a game in 3-D for multiple computers), Super Shell Sort For PET, Atari SuperFont Plus, Creating Graphics On The VIC, Joysticks And Sprites On The 64, Bi-Directional VIC Scrolling, Commodore 64 Video. A Guided Tour, The Atari Cruncher, Easy Apple Editing, VIC Custom Characters For Games.

March 1983: An Introduction To Data Storage (multiple computers), Mass Memory Now And In The Future, Games: Closeout, Boggler, Fighter Aces, Letter And Number Play (all for multiple computers), VIC Music, Direct Atari Disk Access, TRS-80 Color Computer Data Base, Apple Subroutine Capture, PET Quickplot, TI Graphics Made Easy, VIC and Atari Memory Management.

April 1983: Selecting The Right Word Processor (multiple computers), VIC and Atari Word Processor Programs, Typing Teacher, TI Matchem, Retirement Planner (multiple computers), Air Defense (multiple computers), Dr. Video (Commodore), Video 80 (Software for 80 Columns on the Atari), Color Computer Tester, Timex/Sinclair Sound, Estimating TI Memory, Magic Commodore BASIC.

Home and Educational COMPUTING! (Fall 1981 and Summer 1981 – count as one back issue): Exploring The Rainbow Machine, VIC As Super Calculator, Custom Characters, Alternate Screens, Automatic Line Numbers, Using The Joystick (Spacewar Game), Fast Tape Locater, Window, VIC Memory Map.

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And as great as all this sounds, what's even greater-sounding is the price. It's hundreds of dollars less than that of our nearest competitor.

So while other companies are trying to take advantage of the computer revolution, it seems to us they're really taking advantage of something else:

Their customers.

*Manufacturers' suggested list prices.
Monitor included with TRS-80 III only. Commodore Business Machines–PO Box 500R, Conshohocken, PA 19428, Canada–3370 Pharmacy Avenue, Agincourt, Ont., Can. M1W 2K4.

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